CHEMICAL & METALLURGICAL ENGINEERING

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The Travelers Returned

ARRIVING within 10 days of each other, Dr. ELLWOOD HENDRICK and J. S. NEGRU of *Chem. & Met.'s* editorial staff recently returned from extended sojourns in England and on the Continent respectively. Dr. HENDRICK spent 2 months among the chemists of Great Britain, while Mr. NEGRU traveled for more than 6 months throughout the length and breadth of Belgium, France, Italy, Switzerland and Germany. That they have returned with fresh and original points of view on the chemical industry of those countries is the natural consequence of their interviews with men of high and low degree. They had unusual opportunities for observation and will be able to interpret foreign conditions in the language of our readers. Mr. NEGRU'S contributions will begin in our next number with a summary of his views on the cause of the financial breakdown in Germany. Considering the variety of causes that have been assigned for this condition it is interesting to note that Mr. NEGRU feels that Germany has brought disaster upon herself through an unsuccessful effort to wage an economic war on the rest of the world.

In this issue Dr. HENDRICK portrays in intimate detail the peculiar condition of the dye industry in England. There is a point in the history of the British corporation that reminds us of one of the cardinal errors made in the administration of the National Analine & Chemical Co. before it was incorporated into the Allied Chemical & Dye Corporation. Business is an art, and those responsible for the administration of business affairs must make things go. There is no excuse for failure to get along with the men who are needed. Again, business is like the institution of marriage: nobody knows how the parties to the contract are going to get along together, but they *must* get along or make a failure of it. In Buffalo there were the SCHOELKOPFFS, J. F. 2nd and 3rd, who were competent to make dyes and who knew the business. They were bought out because they couldn't agree with men who were lacking in the very knowledge which they enjoyed. They had had unique experience. The art of business required that these two singularly equipped men should have been kept in the organization so that it might profit by their help and their understanding. Conditions in the dye industry in the United States today would have been far better if they had remained active.

In England there was surely nobody having the wide experience in making dyes enjoyed by Dr. HERBERT LEVENSTEIN and quite aside from whatever his administrative ability may be or his capacity to get along with Sir JOSEPH TURNER, he should have been retained as part of the organization. In America we started well and then piffled out. In England they started badly, grew better, but lost a leading trick in the process.

But the most striking feature of the foreign situation is the part that Germany undoubtedly desires and is planning to play in the international control of dye manufacture. It is doubtful if Great Britain will succumb to the German wiles as France and Italy have—at least not on terms that will emasculate the industry and leave Great Britain helpless in time of national emergency. But the situation holds its lesson for those in whose hands rests the welfare of an American dye industry. With France and Italy already controlled and with the possibility of an industrial alliance with Great Britain, the German I.G. may well snap its fingers at the efforts to build a dye industry in this country. If ever conclusive proof were needed of the necessity of tariff protection until technical knowledge and business skill can work out our own salvation, it is to be found in the story disclosed in Dr. HENDRICK'S article. The helplessness of France and Italy will be our portion unless our law-makers get an intelligent comprehension of the importance of the chemical industry to our national welfare.

A Hopeful Prospect for Leadership in the House

FREQUENTLY the chemical industries have looked despairingly toward Washington for an intelligent, if not sympathetic, understanding of their problems. The leaders in the national legislature have often understood other industries, have been sympathetic with and even partial to them, but the chemical industries have enjoyed few friends at court. This is distinctly to be deplored. The chemical industries do not need partiality or even sympathy, but they do need an intelligent understanding.

It is, therefore, with a distinct feeling of hope that the news is received that NICHOLAS LONGWORTH probably will become Republican leader in the House of Representatives on the retirement of Mr. MONDELL next March. LONGWORTH has served his constituency and the country well and ably. In his tenure of office he has won for himself a high regard, not by reason of any spectacular brilliancy but because of his balance, his sane and informed opinion on a great many subjects. His rivals for the post of leader of the party in the House have all suffered severe blows in their own districts in the primaries, and LONGWORTH stands in line for the well-deserved honor.

Chemical industry has reason to rejoice that LONGWORTH will assume a commanding position, for he has held an enlightened opinion on chemical legislation. This does not imply by any means that he has been partial or in any way played the chemical industry as a favorite, but he has understood its problems, and that is the thing most to be desired by any industry as far as Congress is concerned.

Electrochemists Go to Canada

IN OUR news columns will be found the detailed program of the forthcoming Montreal meeting of the American Electrochemical Society, Sept. 21 to 23. It is seldom that the usually excellent programs of this lively organization have afforded so good a prospect of technical discussion and social diversion as the one for the Canadian meeting this month. The sessions on industrial heating under the direction of BRADLEY STOUGHTON of the electrothermic division give promise of unusual interest. Electrodeposition will also receive special attention at one session. The industrial feature of the meeting will be a special excursion to Shawinigan Falls for the inspection of industrial plants at that great Canadian center of hydro-electric power and electrochemistry. Social features will not be lacking. Older members particularly are likely to grow reminiscent over the note that "an old-fashioned smoker" will be given by the local committee, while the novice can be assured that he will be entertained right royally if he attends. The excellence of all the arrangements insures a large attendance and an unusually profitable meeting.

Living Wage And Performance

THE matter of a "living wage" continues to be pressed upon the Railroad Labor Board. In the hearings preceding the decision of the shopmen's case B. M. JEWELL insisted that a living wage was $2,637 a year. Recently the maintenance-of-way men formally demanded that the board recognize the "living wage," claiming that the transportation act requires that this be considered, but the board had ruled otherwise.

The transportation act prescribes as the second of the seven points that are to govern the board: "The relation between wages and the cost of living." Taking this statement by itself, the natural interpretation is that wages are to fluctuate according to the cost of living. In analyses accompanying its decision the board has made comparisons between prescribed wages and those in force in December, 1917, the month before the government took over the railroads; also comparisons between the existing cost of living and that in December, 1917. Confirmation of this view of the intention of Congress is found in the seventh point: "Inequalities of increases in wages or of treatment, the result of previous wage orders or adjustments." Thus even the "inequalities" are limited to those that result from recent acts. Congress plainly assumed that railroad wages in general had been about right, and the chief duty of the Labor Board was to correct divergences.

From the viewpoint of the general economic good and the peace and contentment of the people at large it is to be regretted that the Railroad Labor Board, with the great prestige its decisions must command, is not forced to go into this subject of the "living wage." There are some who consider the whole subject entirely nebulous, because the unions have made the living wage, by inventory, so many shredded wheat biscuit, so many pairs of children's shoes, etc., and each item is open to discussion. Others consider it out of the question, on the ground that "it can't be done"—i.e., can't be paid.

The latter objection brings out the very point that should compel attention to the subject, rather than abandonment of it. The argument is that the total income—i.e., the total production, including the rendering of service with the production of commodities—is not sufficient to give each worker what the alleged "living wage" would buy at present prices. What more sensible thing could be done, then, than set down what is the supply, and allocate it to the workers?

This would furnish the true basis of the "living wage," not what a man ought to have according to his notion of an alleged "American standard," but according to what he contributes to the total. Suppose it be found that the total income is $60,000,000,000 a year, that 25 per cent should properly go for the use of capital and the services of those who manage and invest and 75 per cent to those who work and that there are 40,000,000 workers. The figures taken are near enough the fact to be suggestive. Then rate the workers on a scale with 100 as the base or average. Many would be worth 60, 70, 80, 90, 100, 110 and 120. Some would run up to 150, 200 and 250 and a few would run still higher. The 40,000,000 people would receive a total of $45,000,000,000, an average of $1,125 per capita. Some would receive 90 per cent of this, some 110 per cent, and so on.

Objection may be made that anything of this sort would raise a terrific clamor. The 90 per cent men would claim the 110 per cent men didn't do anything worth while and would be overpaid at 80, and so on. Precisely. That is just what is needed. The psychological influence would be of tremendous value. The trouble today is the public doesn't realize that it pays the coal miner, the bricklayer and the other workers. It thinks the wicked employer merely has to dig down into his pocketbook for the money.

Celebration of Fire Prevention Week

FROM Oct. 2 to 9, Fire Prevention Week will be celebrated throughout the United States and Canada. This campaign will be given all the publicity possible through the newspapers, and will be the subject of meetings, parades, moving picture programs and a special campaign for school children.

With the coal situation in mind and most of us with empty bins, it may be more difficult than usual to concentrate on prevention of fire. But a short contemplation of the present fire situation will amply convince the most worried householder that this campaign will repay all the attention he is able to give it. The annual losses from fires—most of which are preventable—have averaged 15,000 lives and $500,000,000 in property for the past few years. And the yearly figures show these losses to be on the increase.

Fire prevention is an item of daily care to all those in responsible charge of industrial plants. There is no need to remind them that every week is fire prevention week so far as they are concerned. Their chief problem is to sell the idea to all those, employees and others, who may help in this work or who may be the unthinking causes of these losses.

It is in selling this idea that the value of Fire Prevention Week lies for the plant executive. We all remember, from Liberty Loan and War Chest drives, that one of the great lessons of the war was the value of the intensive campaign—the full effort concentrated over a short period—the campaign which drives the idea home and clinches it. By means of posters, motion pictures and mass meetings the need for the utmost care in fire prevention can be made clear to every employee.

We hope everyone responsible will see his way clear this year to putting in the energy, thought and money which are necessary to make Fire Prevention Week really fruitful. Such expenditure will be fully repaid.

Chromium Steels And Alloys

ONE of the first lessons an editor learns is to refrain from superlatives—leave them to his advertisers—so we refrain from calling chromium a "master metal." Perhaps it has been so dubbed. Iron is truly worthy of the title. Other metals doubtless have been given it as well, particularly tungsten, which during the war was hailed as one of the "keys" to victory and economic independence. Tin was another "key," and nations were hard put to discover how they could insure an adequate supply, despite war, embargoes and U-boats.

Tungsten, as a requisite for high-speed steels and a relatively scarce metal at that, doubtless warranted all the attention it got during those busy days of enormous munition production. But its more common partner chromium is no less an indispensable ingredient of high-speed steel—indeed, it is the combination of the two which gives those unique characteristics of modern tools: hardening on slow cooling, gain in hardness on tempering and retention of hardness at red heat.

Nor is chromium's usefulness limited to high speed and air hardening (Mushet) tool steels. Nickel-chromium steels are without doubt the most widely used type of alloy steels; the tonnage comprises a very large fraction of the whole. Inasmuch as they ordinarily contain more than twice as much nickel as chromium, it might be thought that the latter was of distinctly secondary importance. But this is by no means true.

Plain nickel steels are tough and ductile, whereas the addition of chromium hardens the alloy without materially impairing those other advantages. The result is a very strong, tough alloy, which possesses high endurance under repeated loads, and it is therefore widely used for high-speed gas engines and automobiles. No less than fifteen separate analyses have been standardized by the Society of Automotive Engineers, containing some most excellent grades for case-hardening. Carburized nickel-chromium steels give pieces of very hard surface, not nearly so brittle and likely to flake off as the plain carbon steels. Furthermore, the reactions induced in nickel-chromium steels by heat-treatment go forward at such a modest speed that even the interior of fairly large masses of metal can be treated and cooled at a rate which will develop the correct physical properties to the very center of the piece. In other words, mass has singularly little effect on heat-treatment, and this explains why nickel-chromium steels are favorites among armor makers.

Despite the temptation, it would carry us somewhat far afield to cite the properties of the more familiar steels, low, medium and high in alloy content. Suffice it to say that oil-quenching gives them very high strength, with fair ductility but relatively low impact values. (An analysis recommended by the Midvale Steel Co., for structural purposes, containing 0.40 per cent carbon, 0.75 per cent chromium and 3 per cent nickel, may have an elastic limit of 245,000 lb. per sq.in.—near the peak for commercial heat-treated steel.) Tempering such steels must be done with circumspection to avoid embrittlement, but when properly accomplished is able to raise the ductility and impact resistance enormously, although not without a considerable sacrifice in strength.

But plain chromium steels have themselves a unique place in the field of alloys. Chromium, either alone or in combination with iron, forms a very stable carbide, diffusing itself throughout the metal, inducing a very fine grain and corresponding great toughness because of its reluctance to accumulate into sizable masses. The carbide is very hard, and causes the quenched steels to be very hard. Furthermore, the chromium remaining after all the carbon is satisfied enters into solution in the iron and confers great corrosion resistance to the base metal. All these properties produce metal tough and hard, extremely resistant to wear and rusting, suitable for well bits, cold chisels and other shock tools, files and knives, ball bearings, rollers, crusher liners, safes, burglar-proof metal and armor-piercing projectiles.

As the chromium goes above 10 per cent, the region of "stainless steels" is entered. Most excellent and deservedly popular cutlery contains 13 to 15 per cent chromium with about 0.4 per cent carbon. In low-carbon steels, less chromium is needed to retain a silvery finish; furthermore it is cheaper and more easily worked into sheets and forged into shapes. Consequently "stainless iron" is appearing on the market and is said to be winning favor rapidly in England for metal trim of all sorts. But the older "stainless steel" analyses are by no means confined to cutlery—they can assume a wide variety of physical properties by appropriate heat-treatment, and are logical contenders for many machine elements and engineering purposes, from turbine blades to mine cables. Even higher alloys of iron-carbon-chromium have unique properties. Containing 20 per cent and more of chromium, they were developed for their remarkable resistance to oxidation, but have been discovered to possess great tensile strength, even as high as 700 deg. C. Furthermore, the high-carbon alloys resemble white cast iron in hardness and resistance to wear, yet are as tough as a good steel.

This account of a remarkable metal would not be complete without mentioning the importance of certain non-ferrous chromium alloys. Much might be said of alloys of nickel and chromium. They have made electrical heating a commercial possibility. Wires and ribbons of it are universally used in laundry irons, hot plates and toasters, baking ovens and cookers of hundreds of varieties, for bread making, enameling and all sorts of heat-treatment. (In addition to these electrical resistors, several cheaper iron-bearing alloys for resisting high temperature contain more or less chromium as a prime essential.) Another alloy, stellite, is used for machine tools and for surgical instruments. Stellite is essentially an alloy of chromium and cobalt, and contains some tungsten.

However, all these advantages are not to be had without serious effort and expense. Chromium metal and alloys low in carbon, silicon and aluminum are difficult to make, and at present are quite expensive despite the relative abundance of the ores. Chromium oxidizes scarcely at all below its melting point, but when molten apparently oxidizes very readily. Most chromium-bearing alloys, unfortunately enough, are extremely sensitive to oxide inclusions. In steel making, for instance, if there is the least carelessness in the manufacture, if the charge is of inferior scrap or is badly oxidized during melting, if the refining stages be slighted in the least, if the casting and rolling are done in a slipshod fashion, a whole train of troubles and disappointments is in store. Surface cracks, from hairlines to roaks, will abound, flaky fractures will appear, soft spots will follow case-hardening, and a ground and polished surface of a roller or ball will develop markings like an alligator skin.

Like most good things, it doesn't come easy!

Readers' Views and Comments

Dr. Hendrick's English Tour

To the Editor of Chemical & Metallurgical Engineering

SIR:—The visit to England of Dr. Ellwood Hendrick, consulting editor of *Chemical & Metallurgical Engineering*, terminated on Saturday, Aug. 19, when he sailed on his return to the United States. His visit covered just exactly 2 months, and it enabled Dr. Hendrick to see a great deal of the leading personalities in British chemical industry and to inform himself at first hand concerning the special problems now engaging their attention. I saw him a few days after his arrival and a few days before his return. He looked at least 10 years younger for his holiday, was full of praise for the hearty hospitality showered upon him, and more deeply impressed than ever with the essential unity of the two great English-speaking nations. What we shall remember most is the spacious social atmosphere he carries about with him and the large-hearted human qualities which have made him welcome everywhere. He has become a sort of institution at the Chemical Industry Club, London, and at the annual meeting of the Society of Chemical Industry in Glasgow he was one of the most picturesque and popular figures. In fact, he seems during the past 2 months to have been present at every gathering worth attending, and everywhere he has been accepted as a true friend. His big, genial figure, his infectious smile, his good humor, good fellowship and real largeness and kindness of heart will long be remembered by all who met him during his stay; and on his side, one fancies he will carry back to the States equally pleasant memories of the friends and colleagues he dined, and smoked, and chatted with —in public and in private—during his 2 months in the old country.

FREDERICK E. HAMER,
London, England. Editor, *Chemical Age*.

Black Fractures in Carbon Tool Steels

To the Editor of Chemical & Metallurgical Engineering

SIR:—I was much interested in the article on "Black Fractures," particularly so as this phenomenon has been fairly well understood in the tool steel industry for a number of years. It is commonly regarded as a precipitation of graphitic carbon from cementite. This precipitation takes place on prolonged annealing in the region of and immediately below the Ar_1 point. A reference on this subject which has been in print for considerable time is on page 416 of Dr. C. M. Johnson's book on "Rapid Methods for the Chemical Analysis of Special Steels." At the moment I do not recall a paper which gives complete quantitative information upon this phenomenon. Such an account should be written.

J. V. EMMONS,
Cleveland, Ohio. Metallurgist, Cleveland Twist Drill Co.

To the Editor of Chemical & Metallurgical Engineering

SIR:—It is a little surprising that Mr. Green does not recognize this peculiar appearance described in his article on "Black Fractures" in your journal for Aug 9, 1922, p. 265, as due to the existence of temper carbon. The exact conditions under which high-carbon steel sometimes deposits free carbon are not known, but in general we do know that it is the result of bad mill practice. Excessive temperatures in the first cogging operations and low temperatures below the recalescence point in the annealing represent the two conditions which most frequently account for temper carbon.

It is possible for temper carbon to exist up to a considerable amount without showing "black fractures." It is also recognized by experienced tool steel men that steel containing temper carbon can be hardened, but the result in the hardened steel shows a characteristic dry and stony fracture and is very weak in strength. It appears that about 0.90 per cent carbon dissolves readily above the Ac_1 temperature, and this is sufficient to produce hardening. The balance of the free carbon goes into solution with greater difficulty in the heated steel unless the temperature be carried too high for good hardening results. The excess carbon remaining in its graphitic condition accounts for the weak dry structure. The cementite usually passes into globular form just prior to decomposing into iron and carbon when conditions for such decomposition are right.

JOHN A. MATHEWS,
New York City. President, Crucible Steel Co. of America.

To the Editor of Chemical & Metallurgical Engineering

SIR:—The trouble described by Mr. Green as "Black Fractures" has been well known for many years, in connection with the annealing of crucible steel, or any steel of relatively high silicon content, and not containing appreciable amounts of non-ferrous elements that deter, or entirely prevent, the formation of graphitic carbon under favorable conditions of temperature.

It is the property of iron that it cannot retain carbon in the combined state when silicon is in excess of about 0.10 per cent and the carbon is much in excess of 0.90 per cent, if the steel is held for *prolonged* periods at or below 700 deg. C. As H. M. Howe stated in his "Metallography of Iron and Steel," p. 215, graphite is the stable form of carbon and cementite is only a metastable form always striving to change over into graphite by the reaction:

$$Fe_3C = 3Fe + \text{Graphite}.$$

Silicon is the greatest promoter of graphite of any non-ferrous element found to any extent in iron and steel. Mr. Green mentions in his article a steel containing 0.25 per cent silicon. This is quite sufficient to promote readily the "black heart" fracture in a steel where the carbon is as high as 1.15 per cent. If the silicon is much under 0.10, it is quite difficult, if not entirely impossible, to obtain black fracture in the higher carbons—1.15 to 1.35 per cent—by prolonged anneals at the favorable range of 660 to 700 deg. C.

For example, the only way the writer was able to get a precipitation of graphite in "washed metal" which contains about 3 per cent carbon and is very low, usually under 0.05 per cent, silicon, was to heat it for several hours at about 1,050 deg. C. So great is the influence of silicon that Charpy and Thenard were able to graphitize completely all the carbon in steels from as low as 0.40 to 0.14 per cent carbon by raising the silicon content to 4 per cent. In this case the graphitization

was complete in 3 hours at 800 deg. C. With 2.20 per cent silicon, no graphite formed.

Assuming the absence of modifying elements, hypo-eutectoid steels generate cementite at or below 700 deg. C. and hyper-eutectoid steels at increasingly higher temperatures as the carbon content rises, so that for the 3 per cent carbon "washed metal," a temperature just under its melting point is the most favorable.

The presence of two or three-tenths of 1 per cent of chromium is a great deterrent of graphite formation. Also manganese is said to act in the same way. This is due to the formation of much more stable carbides of chromium and manganese. It is quite likely that tungsten and molybdenum act as deterrents also. As spheroidizing anneals and long heating periods tend to promote graphite formation, the heating periods should be made as brief as possible. Repeated reheatings at lower temperatures also tend to produce black steel.

The best use for steel containing considerable graphite, as far as good tool steel is concerned, is to drop it quietly on the scrap pile for remelting.

C. MORRIS JOHNSON,
Research Department,
Pittsburgh, Pa. Crucible Steel Co. of America.

To the Editor of Chemical & Metallurgical Engineering

SIR:—I must admit to Dr. Mathews that I did not recognize the existence of "temper carbon," but did acknowledge that poor or bad mill practice was at times responsible for the production of black fractures. I have found that the steel when hardened has a dry and stony fracture as stated in his letter, and regret that I did not include that observation in my article.

Mr. Johnson's letter I find particularly interesting, and have found in my experience with black fractures that I have verified his statements regarding the rôle of silicon in the production of black fractures. I also agree with him that the scrapping of the material is quite necessary.

Although I never entertained the thought that I was writing anything new when I wrote the article for publication, I am very much interested in the amount of comment it has aroused. It may ultimately lead to the publication of a very conclusive article on this subject. ARTHUR W. F. GREEN,
Metallurgist, The John Illingworth Steel Co.
Frankford, Philadelphia, Pa.

Chemists in Public Life? Why?

To the Editor of Chemical & Metallurgical Engineering

SIR:—After reading S. L. Redman's communication on "Chemists in Public Life" in your issue of Aug. 16 I left my workbench and sat down in the "office" of the laboratory to reflect. Just why do chemists want to get into public life anyway?

Chemists are chemists because they possess an interest in nature. For my part I look upon my 22 years in chemical laboratories about the same way an art student does. I don't want to be in public life; I leave that to lawyers and professional politicians. Lots of us don't want to be executives either; we just want to be left alone. I have been an executive. I became one once because my friends said I ought to be one and that I would obtain a big salary. I was successful. I managed blast furnaces for 3 years, to the entire satisfaction of the owners.

Every time I went to the laboratory and saw my chemist working on the analysis of pig iron, slag or iron ores, I said to myself, I wish I was back in the laboratory again, it is much more interesting than simply being an executive. My work as an executive consisted in trying to see how few men I could employ to man the blast furnace, the smallest pay I could offer to fill vacancies, the lowest coke consumption I could use to make merchantable pig iron, and to doctor the troubles of men, plant and process. I tried for 3 years to feel satisfied as an executive. I found the work uninspiring, tiresome and boring. I resigned to go back to the laboratory. I have been back 14 years and feel glad that these 14 years have not been wasted by simply "being an executive."

Norfolk, Va. RANDOLPH BOLLING.

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have read the letter of S. L. Redman in your Aug. 16 issue with much interest. I heartily agree with Dr. Redman that the laboratory inclination of the product of colleges and universities is traceable directly to the ideas that are instilled at these institutions. But in spite of this training there are some who never regard a laboratory position as other than an introduction to other activities.

There is a class of organizations that should be as severely condemned for fostering this conception of the field open to the chemist. I have heard executives, on receiving applications from men of chemical training, state that their organization did not have any openings that would be of interest to a chemist *because they did not maintain a laboratory.* These managers regard a chemist as useful merely for analytical work and entirely incapable of responsibilities outside of the laboratory. Unquestionably the chemist, individually and collectively, is responsible for this attitude. Many chemists as well as others are willing to accept the order of things as they find them.

The employer who has never retained a chemist in another capacity is loath to try the experiment, usually contending that because a man has never before performed a given operation it is beyond the realm of possibility that he will be able to succeed. When the institutions of learning stop teaching the chemist that his field of endeavor is the laboratory, and the manufacturer, sales organizer, etc., stop conceiving of chemists in terms of laboratories, analyses and expenditures and consider him as a possible asset, economist and producer, then the bulk of our graduates will not be seeking laboratory jobs and the employers will have to find another alibi for "we do not have a laboratory."

East Orange, N. J. A. E. MAZE.

New Source of Creatin

To the Editor of Chemical & Metallurgical Engineering

SIR:—So much research is apparently being carried out by biochemists and others upon creatin and related compounds that it seems desirable to note that a new source of this substance has been discovered which will make it available in much larger quantities than heretofore. Pure creatin will soon be purchasable through regular supply houses at a price which will be a fraction of 1 per cent of the present price; or the writer will be glad to distribute reasonable quantities direct, for research purposes.

It is hoped that this new source of creatin may serve to stimulate research in this field, since the quantities now available will permit research by the synthetic organic chemist as well as by the biological chemist.

The writer will be glad to give further details to anyone interested. GRAHAM EDGAR,
University of Virginia, Professor of Chemistry.
Charlottesburg, Va.

Canadian Meeting American Ceramic Society

THROUGHOUT the week of Aug. 14 Canadian ceramists were hosts to visiting members of the American Ceramic Society on one of the most enjoyable summer excursion meetings on record. Exceptional opportunities for recreation, instruction and good fellowship were afforded by a trip which covered points of ceramic and historic interest from Montreal to Hamilton. The success of the meeting was due in no small measure to the local committee at each point, who arranged programs of plant visits and entertainment and in many other ways looked after the comfort of their visitors. The inconveniences of traveling were minimized through the courtesy of the Canadian Pacific Railway officials, who furnished special parlor cars and sleepers. And no expression of gratitude could be complete without mention of the untiring general secretary, Ross C. Purdy. He alone knows the trials encountered in attempting to keep the little band of explorers intact, particularly when it became necessary to leave behind the shores of Quebec.

As is customary at summer meetings, no technical sessions were held, but three evenings were devoted to Section Q in the most approved pre-Volstead style.

Boat Trip to Montreal

About fifty members boarded the steamer Kingston at Rochester Sunday evening, Aug. 13, for the trip to Montreal. All day Monday as the steamer passed through the Thousand Islands and the famous rapids of the St. Lawrence, old friendships were renewed and new ones formed. It made an ideal start for a week of companionship.

Montreal

Tuesday morning an inspection trip of the magnificent harbor facilities was arranged. Some members also visited the plants of the National Brick Co., Ltd., across the river from Montreal in Laprairie. Excellent common brick, face brick and hollow tile are made at the four plants operated by this company. The common brick plant shown in Fig. 1 has a capacity of about 65,000,000 brick a year. A battery of thirteen dry pans feeds a pug mill and an auger with a wire cutter which turns out brick at the rate of 220,000 to 240,000 per day. Clay is brought from the clay bank, Fig. 2, on dump cars shown in the foreground, Fig. 1. Only half of the building is in use at present, so that the capacity can be doubled when conditions are favorable.

After a delightful lunch in a quaint old French tavern in Laprairie, the main group was rejoined at the Consumers Glass Co., where O'Neill semi-automatic machines equipped with Federal Glass Co. feeders were seen in operation, producing bottles of various shapes and sizes. Certain shapes were also being blown by hand, so that it was possible to compare the two methods. The practice of shipping bottles in bulk by simply stacking them in the cars with a layer of heavy paper between stacks attracted a great deal of attention. Breakage has been found to be extremely low.

Wednesday's activities began with breakfast at sunrise, for the two special parlor cars were attached to the 6:15 train for Ottawa.

Derry Feldspar Quarry

Upon arrival at Buckingham, about 30 miles from Ottawa on the Quebec side of the Ottawa River, automobiles conveyed the party over 10 miles of picturesque roads winding through the east side of the Lièvre River Valley to the Derry feldspar quarry.

This deposit, opened by O'Brien & Fowler in the fall of 1920, contains feldspar which is cream to white in color, analyzing 12.5 to 13.5 per cent potash and 1.75 to 2.15 per cent soda. The deposit has a maximum width of 150 ft., about 50 ft. being practically pure feldspar, while the remainder consists of mixed feldspar and quartz. The richer portion, which is about 300 ft. long, is being worked as an open cut. The method of working is shown in Figs. 3 and 4.

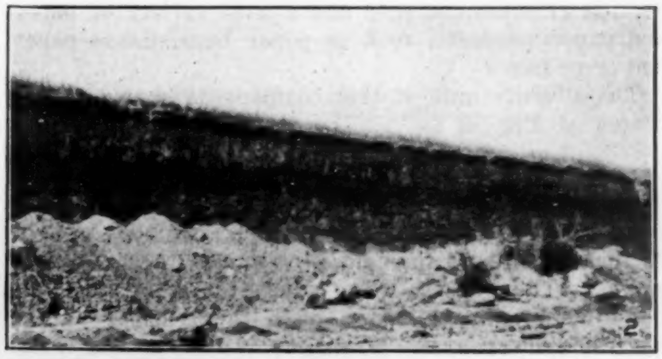
The material blasted from the face of the quarry is inspected as it is placed on 1-ton flat dump cars, small pieces being eliminated through the use of stone-forks in loading. The cars dump into a 100-ton bin on the hillside. Transportation to the railroad varies with the season of the year. In summer, the feldspar is handled 2 miles by wagon to the river and placed in scows, which are towed to the railway siding at Buckingham. In winter, the entire trip is made by sleighs, the frozen river forming the highway for the greater part of the distance.

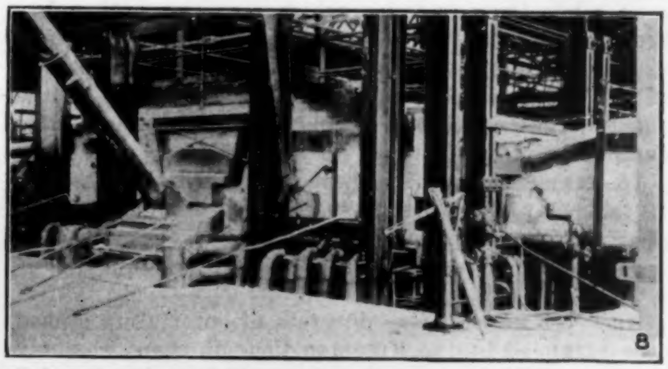
After a thorough inspection of the quarry under the guidance of the superintendent, N. B. Davis, full justice was done to an excellent dinner served camp-style in the mess hall at the quarry. Many will agree that this was one of the most delightful experiences of the whole trip.

Ottawa

Arriving at Ottawa late Wednesday afternoon, the party registered at the Chateau Laurier and then took dinner at Ye Olde Homestead Inn just across from Ottawa on the Quebec side of the river. Later in the evening several members were conducted through the well-equipped ceramic laboratories of the Department of Mines by Mr. McLeish, director, Mines Branch, and Howells Frechette, in charge of ceramic work.

Thursday morning one of the mills of the E. B. Eddy Co. at Hull, Que., was visited. Products of this mill





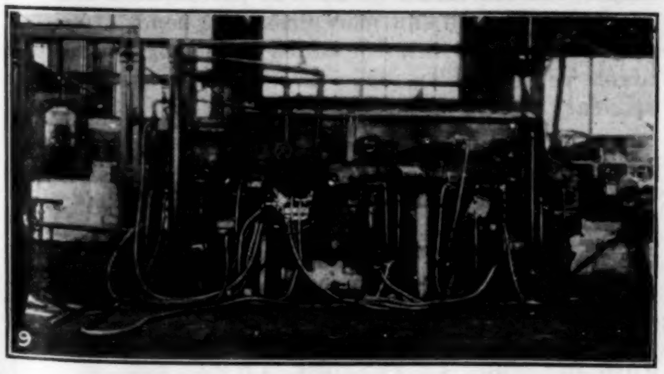


Fig. 1—National Brick Co., Laprairie.
Fig. 2—Clay bank, National Brick Co.
Figs. 3 and 4—Derry feldspar quarry.
Fig. 5—Party leaving mess-hall, Derry quarry.
Fig. 6—Hull, Que. Sulphite mill, E. B. Eddy Co., in center

Fig. 7—Richardson feldspar quarry.
Figs. 8 to 10—Canadian Libbey-Owens Sheet Glass Co.
Fig. 8—Feed end of tank.
Fig. 9—Sheet drawing machine.
Fig. 10—Leer (above) and loading platform (below).

include ground-wood pulp and a wide variety of paper and paper products, such as paper bags, tissue paper and crepe paper.

The sulphite mill of this company is shown in the center of Fig. 6.

Richardson Feldspar Quarry

Near Verona, in Frontenac County, Ontario, is located the famous Richardson quarry, which from 1901 to 1918 furnished most of the feldspar shipped to the United States. The quarry is so situated that a series of handlings was required to place the feldspar at the nearest railway spur. Prior to 1918 labor was cheap enough so that a small margin of profit remained after transportation charges. Since then the cost has become prohibitive and the mine has not been operated. The present owner, R. F. Segsworth, of Toronto, who was active in the development of the Seneca-Superior mine at Cobalt, has interested the Canadian Pacific Railway officials so that the spur is being extended to within 2 miles of the quarry. The connecting wagon road is being finished by the Ontario Department of Highways, so that transportation difficulties will soon be a thing of the past.

About 3 o'clock Thursday afternoon the special cars were carefully pushed to the end of the spur extension. The remainder of the journey—a matter of 3 or 4 miles over the crushed rock sub-base of the new road in lumber wagons provided with rough pine boards for seats—was enjoyed most by those who walked up and back. Those who had the courage and endurance to stick to the wagons insist that the distance was at least 10 miles each way. All were amply repaid, however, by the opportunity to inspect one of the largest deposits of high-grade feldspar on this continent.

The extent of the deposit is apparent from Fig. 7. The pit is about 400 ft. long by 150 ft. wide and 100 ft. deep. All told, about 500,000 tons of material has been removed. About half of this has been high-grade feldspar, while the remainder, which requires sorting, has been left in the form of stock piles, one of which is visible at the upper right, Fig. 7. Pending completion of the new transportation facilities, operations at the quarry are confined to working over and sorting these dumps.

In anticipation of a strenuous return trip, several of the party refreshed themselves by a plunge in the clear waters of Thirteen Island Lake.

Kingston

Although an elaborate program of entertainment had been arranged by the Kingston Council, there was only time for dinner at the Frontenac Club and a hurried inspection of the new Memorial Hall before boarding the special sleepers for Toronto.

Toronto

Friday morning the wonderful harbor developments at Toronto were studied at close range from motor launches.

In the afternoon the party divided for plant visits, some going to the Standard Sanitary Works, others to the Jefferson Glass Co. At the latter plant a pot furnace was in operation and large arc light and street light globes were being blown by hand. After passing through continuous leers the surplus glass is neatly cracked off and the edges ground smooth.

Electric lamp shades of almost every conceivable shape and design are made and the decoration of these forms a most interesting part of the operations at this plant. Some designs are brushed on by hand, plain colors are applied by air brush either with or without the use of a stencil, while many designs are obtained by the method used for decorating china. The design is first etched on a steel plate and the lines filled with wax containing the desired pigments. The wax design is then transferred to a sheet of paper, which is applied to the glass to be decorated. The wax adheres strongly to the glass and the paper may be removed, leaving the design ready for burning. All designs are fixed by heating to a temperature approaching the softening point of the glass used.

Before returning to the King Edward Hotel, the parties reunited for a motor bus trip through the beautiful residential sections of the city.

Hamilton

Arriving at Hamilton by boat Saturday morning, the party at once proceeded to the plant of the General Porcelain Co., where the operations in the manufacture of high-tension insulators were explained briefly. An interesting feature was a test of a large insulator at 300,000 volts.

Next the most modern process for making window glass was seen at the Canadian Libbey-Owens Sheet Glass Co. The mixture of raw materials is fed from overhead bins into a regular producer-gas-fired tank furnace having a capacity of about 600 tons. The feed end of the furnace is shown in Fig. 8. At the back end of the tank is the drawing mechanism shown in Fig. 9. Here a continuous sheet of glass is drawn from the pool of molten glass, the thickness of the sheet being controlled by the speed of drawing. The sheet rises vertically for about 3 ft., makes a right-angle turn while still soft over a roller and then passes horizontally through the long annealing leer, emerging at the far end as a continuous sheet of glass about 6 ft. wide. Two men with cutters trim off the edges and cut the sheet into pieces, which are later cut to size and packed in boxes. Fig. 10 shows the leer on the upper level, the boxes of glass below and the loading platform in the center of the building. There are two complete machines at this plant, each having a capacity of from 3,000 to 3,500 100-ft. boxes per week. When drawing ordinary window glass, the sheet is delivered at the rate of about 6 ft. per minute.

After lunch a small group also visited the plant of the Dominion Glass Co., where Owens automatic bottle machines were seen in operation.

This concluded a week which will long be a pleasant memory in the minds of all who participated and one which did much to knit more firmly the bonds of friendship and kindred interest which have long existed between ceramists on opposite sides of the invisible boundary.

What Goes Into Paper

One hundred pounds of paper, according to a compilation appearing in the house organ of a large paper manufacturer, represents the following commodities in approximately the quantities indicated: Wood, 13.4 cu.ft.; sulphur, 12.7 lb.; limestone, 17.5 lb.; kerosene, 5.7 oz.; bleaching powder, 14.3 lb.; rosin, 3 lb.; soda, 0.515 lb.; alum, 4.2 lb.; color, 1.8 oz.; coal, 320 lb.; iron sulphate, 0.79 oz.; copper sulphate, 0.19 oz.; lime, 3.17 oz.; and 7,500 gal. of chemically treated and filtered water.

The Circulation of Molten Metal by Means of Electrodynamic Forces

BY OSCAR BROPHY

IN CERTAIN types of electric furnaces in which the heat is generated by passing the current through the molten metal, it is absolutely necessary that sufficient circulation be maintained in order that the heat will not accumulate in any one part of the furnace. If the heat does accumulate, the furnace will fail to operate successfully, due either to the volatilization of the metal or to the failure of the refractories.

This statement applies to that type of furnace which is composed of a molten metal bath and a molten metal resistor. The metal is heated in the resistor and at the same time circulated into the bath.

PINCH AND CORNER EFFECTS

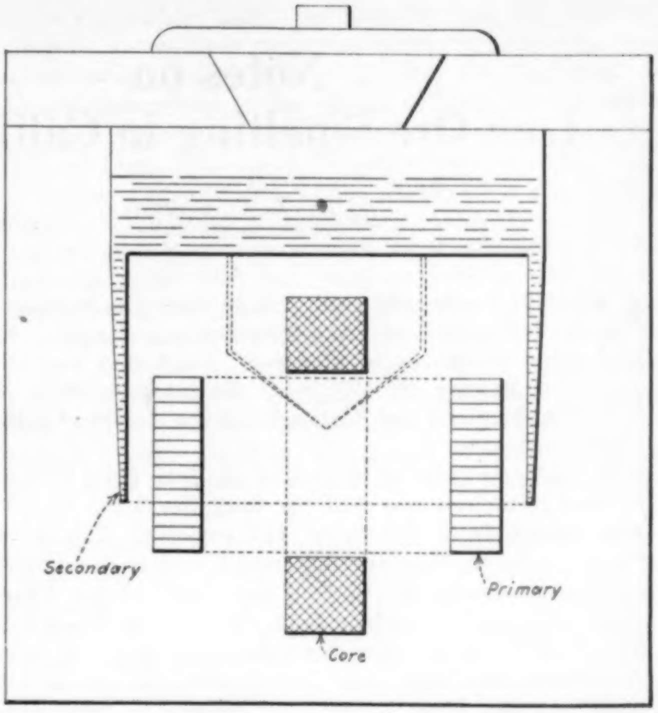
The first furnace of the above type to attain prominence and which depended on an electrodynamic force to attain this circulation was that described by Hering (U. S. Pat. 988,936). This furnace was operated by what is known as the "pinch effect." The explanation of this force which is most easily understood depends upon the fact that conductors carrying currents in the same direction attract one another. Assume that the molten conductor is composed of innumerable strands of molten metal each carrying its current. Then all of these strands will be attracted to one another and will set up a pressure at the center of the molten conductor and cause the liquid metal to flow lengthwise through the conductor.

This "pinch effect" is not dependent on any other external force such as would occur if another part of its own circuit or another circuit entirely were brought near it. We may then say that "pinch effect is the action of a current upon its conductor."

A second electrodynamic force that is used to circulate molten metal is known as the "corner effect" and was also first described by Hering (U. S. Pat. 1,105,-656). This force has also been named "motor effect," but this is misleading, because in most types of motors the effect is obtained by the reaction of two separate and distinct circuits, whereas the "corner effect" mainfests itself in a single circuit. Whenever a liquid conductor carrying a current is made to take the form of an angle there is a force set up in the liquid. This force is strongest at the apex of the angle and decreases as one recedes from the apex. This force depends upon the fact that conductors carrying currents in opposite directions repel each other. Here the turn of the conductor gives the condition of two conductors of the same circuit carrying the current in opposite directions. We may then say that "corner effect is the action of a current upon a conductor in another part of the same circuit."

MOTOR EFFECT

A third electrodynamic force that can be used to circulate molten metal is that set up between the current carrying conductors of two separate circuits. The method of using this force in an electric furnace of the resistor and bath type was first described by the writer (U. S. Pat. 1,296,752) (see figure). This force is made use of in the constant current transformer in which the primary coil of a transformer is made stationary and the secondary coil is permitted to move in a vertical direction and is balanced by weights. The current flow-



ing in the secondary coil is in the opposite direction to that of the primary coil and therefore there is a repulsive force between them. By adjustment of the balancing weight a certain current only is permitted to flow in the secondary coil. If the current should tend to increase, the repulsive force between the two coils will move the secondary coil away from the primary coil and cut down the secondary voltage.

This force was a detriment in the old open channel induction furnace. It tended to repel the molten metal from the primary coil toward the outside when the primary was placed inside the molten secondary. This force was so great as to cause the inclination of the bath of an 8-ton Kjellin furnace to be about 24 deg. (*Stahl und Eisen*, 1910, p. 1071). The uneven level of the metal caused the slag to run always to the inner side of the channel, where the refractory was quickly destroyed.

The action that takes place in most types of electric motors may properly be said to be due to the two separate circuits therein. Therefore this electrodynamic force may be properly termed "motor effect."

We may then say that "motor effect is the action of a current in one circuit upon the current carrying conductor of another circuit."

There is one characteristic of these three forces that it may be well to state. In what parts of the circuit can each force manifest itself? The "pinch effect" will show itself in the resistor or restricted part of the circuit. The "corner effect" will show itself only at corners in the circuit, but the third effect may show itself in every part of the circuit, if properly designed. This is desirable, as the more circulation the more efficient will the furnace operate.

CONCLUSIONS

In conclusion, there are three important electrodynamic forces that may be used to circulate molten metal: 1 Pinch effect. 2. Corner effect. 3. Motor effect.

Pinch effect is the action of a current upon its conductor. Corner effect is the action of a current upon a conductor in another part of the same circuit. Motor effect is the action of a current in one circuit upon the current carrying conductor of another circuit.

Notes on Iron Ore Smelting in California

Pig Iron Was Made in a Small Blast Furnace Operating at Clipper Gap in the Early '80s, and More Recently in an Electric Furnace at Heroult

By R. C. Gosrow
Consulting Metallurgist

SHORTLY after the gold rush in 1849, the necessity of developing an iron industry was foreseen by many of the early pioneers. California was the center of mining activity, and the transportation of iron from England and Scotland and the Eastern United States was slow.

In 1867 the "cost of importing pig iron from Europe to San Francisco was $40 per long ton;" the freight rate varied from $12.50 to $15 per ton. The word "cost" is taken from the old record, and it is assumed to mean the price of the iron laid down in San Francisco. The freight on iron from the Atlantic Coast was $12 to $16 (U. S. currency) per long ton. In 1867 Australian iron cost $40 (gold) per long ton at the wharf in San Francisco. Iron imports in 1866 were 9,388 tons; and for the first half of 1867 they were 2,063 tons.

California naturally had a limited demand for iron products. In 1850 the population of California was only 92,597; in 1860, 379,994; and in 1870, 560,247. In 1880, when the first real smelter was built, the population of the state was 864,694. So from the time the first interest was taken in iron ores and iron production in 1869 up to the actual building of a smelter in 1880 the population of the state had increased 54.5 per cent.

First Location of Iron Ore

In 1854 a deposit of iron ore was known, and had been given some attention on account of its surface croppings, near Clipper Gap, in Placer County. This deposit first had the attention of S. W. Lovell, at that time president of the Bear River Water & Mining Co., and was described by J. Ross Brown, Washington, 1868, in a report on "Mineral Resources of the States and Territories West of the Rocky Mountains," p. 223:

"Robinson, Brown & Co.'s iron mines are located here, about 3 miles from the railroad and 3 miles from the Bear River. These mines were located and patents for the land from the federal government applied for in May, 1866. The company purchased the title of the railroad to the even sections of the land, to the extent of 1,500 acres . . . The ore crops out from the mountain in many places. There are two qualities in the deposit; on the east side it is highly magnetic, while on the west it is very much like the Oregon limonite. Assays made by Kellog & Hueston of San Francisco in March, 1866, gave the following results: the magnetic ore, 64.37 per cent metal; the hematite, 44.67 per cent metal. Professor Jackson of Boston, Mass., states that it contains no phosphorus, sulphur, titanium or other substances injurious to the manufacture of iron . . ."

Early Developments

In order to determine just what might be expected in the smelting of this ore, it was arranged with Coffee, Risdon & Co. to erect a furnace on the property to test out the ore on a practical scale. After many urgent efforts the scheme was abandoned. In June, 1857, a sample of the iron ore from the Lovell property was sent to San Francisco for testing. In tests run on this sample it was found that the ore "yielded 83 per cent iron." Nothing more was done with this property for many years, and although the property was inactive, its early publicity seemed to promise more for the state.

From 1858 to 1862 very little is reported on the development of iron ore mining. In 1862 and 1863 several deposits of iron ore were reported in Sierra County and elsewhere.

In 1867 magnetic iron ore was found on Grouse Ridge, 14 miles from Washington, Nevada County. Magnetic ore was also discovered near Chapparal Hill, Butte County, near Grizzly Creek; it was reported that this ore contained 65 per cent iron. In Sierra County the ore deposits were considered of great value. A deposit was discovered by its surface croppings 12 miles from Downieville at an elevation of 6,200 ft. Baron von Richtoven said of this ore in a report to the owners: "Your mines consist altogether of magnetic iron ores, and the same as from which the celebrated Swedish and Russian iron is manufactured. A total amount of ore which may be extracted from different deposits by quarrying I estimate to be 1,400,000 tons—average yield 45 to 50 per cent iron. Even the removal of the ore next to the surface will be the work of a generation."

In 1869 the firm of Robinson, Brown & Co. shipped ore from the Clipper Gap mine to the Pacific Rolling Mills in San Francisco. It was reported 20 tons was shipped in July of that year. No analysis of the ore is given in the records.

First Incorporation

In December, 1869, a company was incorporated in San Francisco, under the name of the Iron Mountain Iron Co., with a stated capitalization of $500,000, and was composed of the following men: J. R. Brown, G. W. Applegate and A. G. Neal. They are described as "men of limited means." The purpose of the company was "the mining of iron ore and the smelting of pig iron." This was over 15 years after the deposit was first discovered, and the year following Mr. Brown's examination.

As pig-iron manufacture was a new industry in California, it was expected it would need all the support it might be possible to acquire to encourage its establishment and growth. State legislation was one of the means considered suitable, and in February, 1870, Assemblyman Waldron of Placer County presented a bill known as "An act to encourage iron mining." The provisions were: that when the company had reduced 2,500 tons of merchantable pig iron the state should

pay the company a bonus of $12 per ton; also, the state should pay to the company annually for 10 years an amount of money equal to the taxes that would be due on iron and products of the mine, if they were assessed at the market value in San Francosco; and refund to the company money paid as taxes on its other property. The bill also gave the company 5 years in which to produce the 2,500 tons of merchantable pig iron, and in default of such production the state did not pay the company anything. Gov. Haight vetoed the bill.

Like many new enterprises, the company was short of the necessary capital to carry out its program. It was forced to discontinue, and the ore was left to remain in the hills. But in 1874 a Mr. P. Fitzhue came to examine the property at Clipper Gap. His interest was derived from reading the report of Professor Whitney, in his volume on the "General Geology of California." Plans were laid for the formation of a new company to work the property, but nothing of note was accomplished until 5 years later.

Blast Furnace Built at Hotaling

In 1879 the California Iron Co. was incorporated by E. Judson, A. P. Hotaling, Mr. Scott and Mr. Fitzhue. This new company purchased the property at Clipper Gap and at once commenced the construction of a smelting plant, and the establishment of a town site, called Hotaling, 3½ miles from the Central Pacific R.R. In 1880 this company erected a modern blast furnace at the property, with the necessary buildings, to carry on the mining of iron ore and the smelting to pig iron.

The blast furnace was constructed on the same lines as a furnace at one of the South Chicago steel plants, but was smaller in size, having an expected production per 24 hours of 25 tons. The stack was 47 ft. high, 13 ft. in diameter and had five tuyeres. The furnace building was 150x200 ft., and accommodated thirteen pig beds. A 135-hp. horizontal blowing engine supplied 4,000 cu.ft. of free air per minute. The pressure at the tuyere is not given. Blast was heated in a stove, consisting of 56 tons of iron tubes, heated by furnace gases. Marble was available for flux. The reducing fuel was pine charcoal made from local woods. The company operated three charcoal camps, 3, 6 and 8 miles respectively from the works. The kilns were the beehive type, 29 ft. high, 32 ft. in diameter, and held 45 cords of wood, producing 2,250 bu. of charcoal from a charge. Production figures cannot be derived, but as the furnace had a production of a ton of iron per hour at least 30 tons of charcoal was needed per day.

The first iron was tapped on April 24, 1881. A typical charge was: ore 800 lb., marble 30 lb., charcoal 500 lb. From this charge the charcoal to pig iron was 1 to 1, or a ton of charcoal to a ton of pig iron. The pigs cast weighed 90 lb. each. Labor at the plant was distributed as follows:

Furnace hands	50
Mining ore	40
Charcoal burners and teamsters	75
Incidental	12
Total	177

The grades of iron produced were Nos. 1, 2, 3 and 4 foundry; some forge iron was also made. This iron brought $8 to $10 a ton more than Eastern iron in the local markets.

In September, 1881, the foundry and the machine-shop buildings were destroyed by fire and the plant was temporarily closed down. It was the intention to resume operations in the spring of 1882, but the plant was not opened up again, and the California Iron Co. retired from business in the latter part of 1882.

During the operations from April 24 to the closing down of the plant in September, 1881, 4,414 tons of pig iron was produced, an average of 800 tons a month. Records do not say, but in all probability the greater tonnage was shipped to San Francisco and the iron foundries around the Bay.

The operations of this company were attended by many adversities. "Some of the construction work was defective and required being done over." Many blunders were made in the design of the equipment, as well as in operations, all of which absorbed the profits of the venture.

The California Iron & Steel Co. succeeded the California Iron Co. in 1882 with the intention of enlarging the scope of operations by producing steel bars and shapes. There seem to be conflicting records on further operations at Clipper Gap smelter. One record states: "In 1882 production was somewhat larger than the preceding year," but the "History of Placer County" states that the smelter closed in 1881 after the fire and did not resume operations. While 1,002 net tons of iron ore was produced in 1882, it did not necessarily go into pig-iron production, as the lead and copper smelters used considerable tonnages of iron ore. By this time there were also some steel furnaces in San Francisco.

Rolling Mills in San Francisco

An outlet for California-made pig iron was a certainty. In May, 1866, the Pacific Rolling Mills was organized and in July, 1868, the first bars were rolled. In 1881 this works employed, together with other iron-working establishments in San Francisco, 1,200 people. Eventually the company consumed 18,506 tons of pig iron annually, and produced 16,500 tons of bars. The Benicia Agricultural Works made plows and agricultural machinery; it melted the Clipper Gap pig "with a little Scotch mixed in to get the best combination of toughness and hardness." A plant in Oakland was also run in connection with the Clipper Gap mine, converting its product into iron and steel.

In 1880 there was imported into the state 13,200 tons of pig iron. Pig-iron consumption in California is given at 12,250 tons in 1881, of which 4,500 tons was produced locally, and the remainder imported. The value is given at $337,000, or $27.50 a ton. From 1875 to 1880 the average price of pig iron in San Francisco was $29.75 a ton. With locally produced pig iron, furnace owners promised to lay iron down in San Francisco for $24 a ton. With the Clipper Gap iron selling at $8 to $10 a ton over Eastern iron, a good profit must have been made on this iron at $33 a ton for No. 3 or 4 grade.

Noble Steel Co.'s Operations on Pitt River

In the following years some new deposits of high-grade iron ore were discovered. Notable among these was the Pitt River iron mine in Shasta County, near the Pitt River, a rich magnetic iron ore, averaging 65 per cent iron with under 0.02 sulphur and 0.02 phos-

phorus. The Herz Mountain deposit contributed iron ore to the Bully Hill copper smelter, as did the Pitt River iron mine also.

No developments on a commercial scale took place until 1907, when H. H. Noble of San Francisco formed the Noble Electric Steel Co. to smelt the Pitt River ore by the electrothermic process. Dr. Paul T. Heroult was engaged to come from France and design and build the first furnace. The townsite, named Heroult, was located 8 miles from the junction with the Sacramento River.

Initial operations at Heroult were coincident with the development of large waterpowers on the west slope of the Sierra Nevada Mountains, and within a short transmission distance from the proposed smelter. It was hoped to convert electrical energy into heat in a proper furnace and smelt the local iron ore to pig iron. Adjacent to the iron ore there was a deposit of pure limestone for flux, and the wooded hills presented a supply of wood for charcoal. In 1908 the first furnace was completed and put in operation. A plant was built later to make charcoal from pine wood, and to recover the byproduct.

Experiments With Electric Furnace

The first electric furnace was a rectangular type of furnace with three electrodes—large blocks of carbon, built up from smaller pieces. No one in this country was making carbons of the size required for this furnace, and as a consequence they had to be imported from Europe. Many interferences developed, and this furnace was operated intermittently for only about 3 months.

From 1909 to 1911 a new furnace was developed of the circular type, using a superimposed shaft down which the ore and charge descended to a larger crucible below. The electrodes entered the crucible at an inclined angle, through a dome-shaped roof. This furnace had an electrical capacity of connected transformers of 1,500 kva.; it produced about 10 tons of foundry iron daily, consuming on an average 0.34 hp.-yr. per ton of iron.

In 1911 the furnace was changed back to the rectangular type, but instead of the straight delta connection with the three electrodes in a line as in the first furnace of Dr. Heroult, the furnace had four vertical graphite electrodes in a straight line, and the delta connection was open, with the first and fourth electrode at the ends.

This furnace presented many features which required perfecting before it could be pronounced a success. The transformers connected had a capacity of 2,250 kva., but certain power conditions required the installation of a fourth 750-kva. transformer on one phase, to carry a circulating current due to low power factor. It was difficult to feed the furnace properly and keep the stacks open for the charge to come down into the furnace. Hang-ups in the stacks caused the refractory arches through which the electrodes entered the furnace to burn out. No end of delay was caused by such improper feeding. Often, after a hang-up the charge would drop and break an electrode.

Throughout 1911 and 1912 the features which caused trouble were gradually eliminated, and the furnace steadily produced 20 tons of foundry iron a day. Power consumption was about 2,700 kw.-hr. per ton of pig, and the furnace averaged 20 hours a day on load. In 1913 a second furnace of the same general design as the one just described was built, with six 750-kva. single-phase transformers (two transformers on each phase connected in multiple). The furnace was 27 ft. long, 10 ft. wide and 10 ft. deep from the bottom to the electrode holder. It was operated through the winter of 1913, but closed down in the spring of 1914. Severe power troubles in the mountains caused many delays in the winter of 1913.

In 1913 the company built a modern twenty-retort byproduct charcoal plant; to supplement this production some charcoal was purchased from Mendocino County.

All through these operations on pig iron the fact was demonstrated that for an electric furnace to produce a concentration of heat, a steady, even feed of the charge must be provided; electrically a constant load must operate over a constant period of time. The best operations showed 5 per cent of delays; "power-off" was the worst interference—it always took at least twice as much time to come back to normal working. In 1914 the company ceased making pig iron and turned its plant over to ferromanganese.

This plant at Heroult presented many advantages as well as disadvantages for the production of pig iron. It was considered that the proximity of power, ore, limestone, wood and transportation would assure the commercial success of the enterprise. Situated only 280 miles from San Francisco and the Bay cities, a market awaited the product. Being in a region where other smelters were operating on copper ores, skilled labor was available. But many things acted with equal force in the opposite direction.

Possibilities of Electric Smelting

Electric smelting of any ore was a new branch of metallurgy. There existed no precedents derived from the experience of others in this particular art. No one knew of the fitness and adaptability of the proposed equipment; if unsuitable, it was discarded before its use had even paid for itself. Another serious handicap was the difficulty of obtaining men to design and build the equipment. The decision to smelt iron ore in an electric furnace patterned after the shape of an iron blast furnace did much to delay the development of the right type of furnace. Reactions in the electric furnace take place in an entirely different way than those in the blast furnace, and this caused many mistakes in the grade of pig produced. Often when foundry iron was wanted, white iron resulted. Shortcomings in the electrical equipment often caused much trouble, so that the required load to generate the necessary smelting heat could not be carried. Charcoal was considered to be the ideal fuel on account of its bulk, its electrical resistance, its freedom from sulphur and phosphorus and its availability. But the cost of even byproduct charcoal was so high that when 800 lb. of charcoal was required per ton of pig iron, it made the price of pig too high for local purchasers.

When electric pig iron was first sold to foundrymen, they objected on account of the close grain as compared to blast-furnace iron. They graded the iron on fracture, and the electric iron was sold on analysis. As the fractures did not compare for the same silicon and sulphur contents, the foundrymen were skeptical. This prejudice had to be overcome, and it eventually was.

As byproducts from oak wood are more valuable than the byproducts from conifers, it was not possible or feasible to get sufficient oak, so the cost of the charcoal was higher than it should have been.

However, electric pig iron, wherever it was used, produced castings of extreme fineness and softness. Foundrymen liked the iron, but unless they could get a higher price for their castings made from electric iron, they would not buy it. As a consequence electric iron had to be sold in competition with Southern and Midwest blast-furnace irons. Often foundrymen used electric pig to mix with other irons when they had particular castings to produce.

These and many other causes contributed to the circumstances which made the establishment of the electric smelting process so difficult and so slow.

It must be considered, however, that in the early years at Heroult the process was by no means a commercial one. Production of pig iron was carried on under restricted schedules, during which time the correct furnace was evolving. Simultaneously the development of the company's iron ore property was going on, and in 1914 there was enough ore blocked out with an average iron content of 65 per cent to run the smelter 50 years on a 50-ton-a-day basis. With the development of the Pitt mine, the mills in and around San Francisco purchased this ore for their open-hearth and other furnaces. It was mined in an open pit, and delivered to standard railroad gondolas a mile distant.

With the World War instigating every metal producer to do his utmost, the company went into the manufacture of ferro-alloys in 1915, and did not again produce pig iron, with the exception of a small amount made in some experimental work. During the Noble Electric Steel Co.'s operations on pig iron during 1911 to 1914, it produced approximately 3,500 tons of salable pig iron. The charcoal ratio to pig iron was about 1 to 2.5.

Reduction of Iron Ore With Fuel Oil

Just prior to the electric smelting operations at Heroult in 1907 and 1908 there were many attempts made to reduce iron ore by the use of California fuel oil. While these efforts never developed beyond the experimental stages, historical mention should be made of them. Generally the idea was to utilize the fuel oil as the prime heating agent, and by the use of pressure or suction force the mixed oil and air into the furnace through a tuyere. Experimental furnaces were often built along the general lines of a vertical blast furnace, and fed through an air-tight bell at the top. Many types of burners were used, so that the correct mixture of air and oil might be taken into the furnace. Reducing material was charged separately with the ore. These processes were never a metallurgical success, because the reduction of the iron ore in such a manner could not be controlled. Instead of reduced iron being tapped, the furnace more often discharged ferrous oxide and an iron silicate slag.

Contemporaneous with these attempts experiments were carried on to reduce iron ore to sponge iron, and then melt the sponge iron to steel in an electric or other furnace. One such installation comprised a 15-ton, double three-phase electric hearth furnace, with a gas outlet in the side above the metal bath. This gas outlet was connected to a hopper-bottom concrete tower, about 20 ft. high and 42 in. in diameter lined with refractory brick. It was attempted to reduce a charge of iron ore in the reducing tower to an iron sponge, draw off the iron sponge, charge it in the electric hearth furnace and melt it, and build it up to the desired steel analysis required. Gases from the reactions in the steel furnace were to furnish the heat required to reduce the ore in the stack. After the first charge was made in the reducing stack, the process was started and the cycle was supposed to repeat itself. This process was in actual operation, and while the metallurgy of the process was simple, yet the mechanical features were far from a success. The charge in the reducing tower partly fused and the whole mass would hang in the tower and prevent further gas circulation. Due to the heavy expense of conducting experiments on such a scale as this, and with the small measure of reward, this process was discontinued.

Dreamers, and even metallurgists, had hoped that in some way a process might be revealed to them that would bring together iron ore and California fuel oil in such a manner that pig iron would result. Types of equipment of every conceivable design were proposed in patents and plans by those interested. No attempt is made to list these; only those that have actually been tried on a considerable scale have been referred to. None of these schemes has consumed enough iron ore to classify it as a commercial process.

Present Situation

Thus, in California there have been only two plants which have really entered the market as commercial enterprises. These two have been described in some detail, even though neither is now operating. Other plants, including the steel plants in the Bay region and in southern California, have tried direct reduction of iron ore, but nothing has yet resulted from these experiments. As consumers of iron ore, and one might say in the broad sense "smelters" of iron ore, the steel mills are the largest, so that outside of some chemical industries the steel furnaces now consume practically all the iron ore mined in California.

The iron ore resources of the state are quite well outlined in several bulletins issued by the State Mining Bureau. Principal among the potential iron ore properties are deposits in San Bernardino County, in the Eagle Mountains, the Minaretts of Madera County and the Placer County and the Shasta County deposits. Given shipping facilities from any one of these to tidewater, a reduction plant could operate on a scale large enough to furnish the Pacific Coast with its pig iron.

Catching Zinc Fume

At the recent Vancouver convention of the American Institute of Electrical Engineers, it was stated by E. P. Dillon, general manager of the Research Corporation, that it has now become possible to catch zinc oxide from furnace gases. An application of recently discovered principles (described by Evald Anderson in this journal, Jan. 25, 1922) has made successful several commercial installations handling up to 20,000 cu.ft. of gas per minute, at temperatures as high as 700 deg. F. The fume content of these gases has been as high as 5 grains per cu.ft. (standard conditions).

It is necessary to "condition" these gases by adding steam or water. Even from these humid gases the deposit comes down dry.

The Dye Situation in Great Britain and Elsewhere

A Survey Based on Authoritative Information Gathered by the Author at First Hand in England — Outline of German Proposals to Participate in Dye Industries of Other Nations

BY ELLWOOD HENDRICK

IN GREAT BRITAIN they have the British Dyestuffs Corporation Ltd. besides Scottish Dyes, the British Alizarine Co. and one or two others making specialties. British Dyestuffs is the leading company. In France there is the Compagnie Nationale des Matières Colourantes; in Italy there is a somewhat similar establishment, and what we in America have the Lord knows. In Germany there is the Interessengemeinschaft der Deutschen Farbstoffwerke, or the I.G. as it is called.

British Dyes started during the war with a great blow of trumpets and a large expenditure of money, taking in the works of Read Holliday's Sons at Huddersfield, and building elaborately, expensively and in haste. At the same time Levenstein's Ltd. of Manchester waxed great, the works extending over a mile in length, with about 3,700 men employed. In the course of time Levenstein's Ltd. was taken in. British Dyes became British Dyestuffs Ltd. and a dual management was established, with Sir Joseph Turner of the former Holliday concern to look after business matters, including purchases and sales, and Dr. Herbert Levenstein, an acknowledged authority in the subject of dyes, as technical head. The British Government had a large investment in the works and has had considerable to say in recommending appointments.

CHANGES IN MANAGEMENT

Levenstein's Ltd. and Read Holliday's Sons had always been rivals and Dr. Levenstein and Sir Joseph Turner were not meant to work as a team in double harness. But development proceeded. Professor Green, discoverer of the primaline dyes, was retained for research, and Professor Robinson, who is said to be a second Emil Fischer in organic chemistry, was also brought in for the same purpose. There was lacking, however, any co-operation between research and manufacture with the department of sales, purchases and business. So Dr. Levenstein tendered his resignation unless Sir Joseph Turner were replaced by somebody he could get along with. Here the guiding voice of the government urged harmony and waiting, until an impasse was reached and then both Dr. Levenstein and Sir Joseph Turner were replaced by Sir William Alexander, the present head.

Sir William is a man of signal ability in business affairs. He has been largely interested in the making of heavy chemicals, was closely assosiated with K. B. Quinan in the manufacture of munitions during the war, and has been heretofore signally successful in all his undertakings. He is a man of high character and reputation. He found that research had so far outstepped production that about 20 per cent of the research chemists were dismissed. Manufacture was reduced so as to be made co-ordinate with sales, and for the general works manager, C. J. Burnham was selected, a gentleman who had been successful in the production of munitions in England during the war and associated with Quinan in making explosives in South Africa and India. The sales force was generally reorganized and co-ordination of research, manufacture and sales departments was established. The various men in authority in the three departments of research, manufacture and sale now meet with the managing director every Wednesday and work is planned ahead with a view to meeting every need as it arises. New dyes are introduced as soon as factory practices, evenness of quality and the satisfaction of all three departments are attained—and not before.

BRITISH PUBLIC SUPPORTS INDUSTRY

Now it is a long, long road to Tipperary and to several other places, among which is the goal of making dyes for the British or any other market in the face of German competition. Even with the 10 years' embargo, when Germans offer goods at an amazingly low price—at a dumping price—the temper of manufacturers and of the dye commission is strained. But the British public is alive to the fact that, given complete failure of the industry in England and America and elsewhere outside of Germany, and given also the success of the Junker Partei in Germany (under whatever name it functions), then the next generation is likely to know what gas attacks mean as never was known before.

The position which Sir William Alexander is straining every effort to attain, and it goes without saying that he is bringing all his great abilities to this end, is to keep the good will of British dye users so that they will take native dyes in preference to those of German make, provided always that they are as good and as regular as German goods, *but not otherwise*. In regard to prices he holds it to be his obligation to meet the needs of British dye users before the interests of stockholders are considered. Further in regard to prices, he holds that these should be standard for the same dyes over the whole world. He is willing to make international trust agreements as to quotas of sales and markets, but provided only that the British corporation remains inviolate as it was founded: a dye-making concern. If such agreements cannot be made adequate to British needs, both in peace and in war, then the profits of the business are bound to be small all around, but he has faith that the industry will still endure in Great Britain.

At the annual meeting held on June 23 there was shown profits on operations for the year of £437,683, but owing to reductions in stock values the management wrote off £1,444,343, indicating a loss of £1,006,660, but leaving cash assets in excess of £1,000,000. The meeting was not harmonious, although the regular ticket was elected by about two-thirds of the shares represented. Dr. Levenstein, who is the largest shareholder, refused to make any comment on the chairman's report on the ground that the corporation's best interests would be served by such a course.

The opposition held that the corporation now lacks

proper scientific and technical control. The dye industry, according to the opposition, differs from others in that it is an establishment of standardized processes rather than products, which must frequently be supplanted by new dyes, and that it is, therefore, always in a state of flux. Novelties must be brought out, not only for profit but for the welfare of users of dyes. Again, far greater patience and faith are required than in making other products; and any attempt to organize this industry along lines familiar to other branches of manufacture except, perhaps, fine chemicals, cannot succeed. The management holds that provision has been made in these respects.

Sir William Alexander declares that government participation in the corporation is in no sense a burden and that indeed from the government he gets the very strongest support. This is fortunate, because in the formative period, according to current expression, the hand of the government was heavy, appointing men to represent it and in authority who were wholly uninformed as to the needs of the business. In other words, it made political appointments. Of course, the only way to make progress in this very complex industry is to let the real leaders develop themselves and then to recognize them as such.

Conflicting Views on British Dyes Ltd.

Now, in England, one hears conflicting stories about British Dyes. One is that they are working along against serious odds, but that they have the backing of the color users, that they are proceeding under sound business administration, with good *esprit de corps* and general good will and the advantage of a license system with 7 years to run. They are overcapitalized as a result of war conditions and mistakes, rather than of high finance. They are proceeding on good principles of business, but from many sides one hears the criticism that the weak point is in technological experience. They lack any outstanding dye technologist such as one may find in every works that has achieved success. They are starting largely without experience; with no one like J. F. Schoellkopff 3rd or Dr. Herbert Levenstein to look ahead for them.

Now let us take an entirely new view of the problem. On July 20 the *Chemiker Zeitung* (No. 86, p. 656) contained the following note: "Farbstoffe: The efforts of the I.G. to close a contract with the English works similar to that closed with the French and Italian works (cited from *Chem. Zeit.*, 1922, pp. 404 and 448) has thus far not resulted in any definite conclusion. The first meeting took place, according to the *Yorkshire Evening News*, shortly before Christmas in 1921, in Paris, at which Carl Weinberg of the I.G. and W. Alexander of the British Dyestuffs participated. In May of this year they met again in Berlin, at which Lord Ashfield, the government representative of British Dyestuffs, was also present. Now the Englishmen await new proposals from the German representatives, inasmuch as they are not disposed to conclude any arrangement which will place the English industry where it stood before the war. And the conclusions of the British representatives will require also the approval of their own government."

Franco-German Working Agreement

Of course that does not tell everything. In the *Times* of London on Aug. 1 there is an article headed "French Dyestuffs, An Alarming Rumor," and there follows a quotation from the annual report of the Compagnie Nationale des Matières Colourantes as follows:

> The work of even the best technicians must be sterile unless they are in possession of all the knowledge accumulated in the past—knowledge which is essential to success. All who understand the complexity of the manufacture of organic coloring matters will realize why we have been compelled to acquire the patents, the processes, and the technical aid of our principal foreign competitors for exclusive use in France. Thus we have at our disposal the results of 50 years of investigation and processes minutely studied and methodically put into practice, and so we are immediately placed in a position equal to that of the most modern and most specialized firms in our industry.
>
> Certain sections of the French press affect to perceive in this statement confirmation of a rumor long in circulation that the Compagnie Nationale has entered into an alliance with its German rivals.
>
> It is recalled that not long ago the *Chemiker Zeitung* announced that an agreement had been entered into between the German and French dye industries, in which seven great German firms and the Compagnie Nationale des Matières Colourantes were associated, by which the German firms were to give the French company detailed technical assistance and full information concerning the processes of manufacture and to supply German chemists to supervise the application of the processes in French dye works. In return, it was stated, the Compagnie Nationale undertook to limit supplies of certain synthetic dyestuffs to France and her colonies, and to allow the German firms a share of the profits.
>
> There is therefore a national anxiety to know to what extent the French industry is dependent upon foreign, and particularly German, aid.
>
> It is not merely a question of supplying French industries with French dyes. It is remembered that before the war the dyestuffs factories in France were in the hands of Germans. When war broke out there were neither materials nor workmen to produce dyestuffs, and in consequence no adequate provision for the manufacture of asphyxiating gas and explosives. If the Compagnie Nationale ceased to manufacture dyestuffs, it is argued, and if the day should again come when the rapid manufacture of explosives is necessary, France would find herself unprepared as she was in 1914.

This confirms the statement of the *Chemiker Zeitung* as to the agreement between the I.G. and the French company, and we learn from competent authority that the working agreement is already closed.

Will Government Approve an Agreement?

A subject that one hears occasionally discussed is whether the I.G. and British Dyestuffs will come to some similar agreement and whether, then, the government will approve. In Sir William Alexander's address to the stockholders he said in regard to this: "While we would welcome an arrangement with the German undertakings, it must be on such terms as will leave inviolate the principles on which your undertaking was founded—namely, the establishment of a dye industry adequate to our needs both in peace and in war. So far, however, the German interests are not of the opinion that circumstances are such that they are prepared to accept the fundamental principle which we have laid down as a basis for close negotiation."

An opinion that one hears occasionally expressed at clubs and over lunch tables when the subject is brought up is somewhat to this effect: "The Germans are beaten in war and it is up to them to make good. We don't want their steels or their textiles, because by taking them we cause our own mills to shut down. Real money they haven't got, and yet they owe for damages. Very well, let them pay in giving over their 40 years' advantage in dye-making experience and mark off some of their debt by the operation. Within the past 2 months this

idea seems to have gained some currency, but the writer is unable to record how widespread or how generally it is held or whether such a thought has been touched upon in authoritative conferences.

The German idea seems to be to establish a British working agreement similar to that closed with the French and Italian companies: the I.G. to remain German and the other corporations to remain native with no exchange in ownership of stock. Information to be made common property and chemists and engineers familiar with processes to be transferred back and forth as needs arise. The *quid pro quo* to be a division of the profits before payment of dividends, and allotments of tonnages and territory to be agreed on, all for a long term of years. It makes the I.G. the nucleus of an international industry, participating already in that of France and Italy and prospectively with that of Great Britain. It is evident that on this basis the minds of the British and German negotiators have not met.

We do not know what arrangement has been made between the I.G. and the French company in regard to products or processes that may originate in the French company's laboratories or works.

Now let us do a little guessing. Suppose the minds of the British authorities and those of the I.G. should meet as to terms. The British Government, with its large interest in the enterprise, would have to approve. It dare not proceed too sharply counter to public opinion. And what has public opinion to say?

Are the Germans Sincere?

Here, for instance, is a question that one hears frequently today and that may be asked with persistence when the problem at issue is discussed: Are the Germans to be trusted? In England as in America the impression is widespread that the Germans have done things of which civilized people would be ashamed, and if they do not know it was wrong it is because they do not know what other people do know in the art of living at peace with the world. Time was when Germans were hailed and made welcome almost everywhere; now they are, in a way, *declassée*. Germans do not admit this; against the charge that they should be ashamed they claim that they are an ancient and a proud race, but all the time they know of their inhibition and it hurts.

Today they are a crippled people and they want to get back into the sphere of international comity. Without admitting fault or wrong, they admit this much. International agreements in so overadvertised a domain as dyes would help to bring it about. But is that all? How does the German mind work? Do they propose to fall on the necks of their late enemies and give them of their best, their most cherished possession, to establish an era of good feeling? To make a great gift and then to hope for the best? The German mind is addicted to habits of careful planning and to the study of situations, according to its lights. Therefore, to a proposal so loosely drawn as this appears to be we should expect lively objection from Hugo Stinnes, Professors Duisberg and Nernst, from General Ludendorff, Herr Helferich, "Organization C," the "Selbschutz" and associations of professors and teachers and leaders of German thought who seem unanimous about the "crime of Versailles."

So let's do a little more thinking about the subject. The wealth of a nation is not in its dye business. To forego profits on some goods exported and to get part of them back on goods made and sold abroad is not such a great loss. In view of the present difficulties of export the German proposal might involve no loss at all. And surely international agreements would do more than anything else to bring about international comity.

But future warfare is chemical warfare. Politicians do not know this outside of Germany. Neither do the majority of military men—outside of Germany. The Germans failed to take Calais because even their own military leaders did not know it when they made their first gas attack. And what would ensue from the participation of the German trust in this key industry of other nations? Observe, please, it is not proposed that allied industrial corporations participate in the I.G. The German trust would then be posted as to the situation in, and the facilities of, every other country.

Success in Chemical Warfare

Now the philistines are right when they say that making dyes and intermediates does not alone provide for offense and defense in gas warfare. Offense in gas warfare is provided by the capacity and equipment to produce in great quantity unknown gases of great lethal power for a strategic surprise. Knowing the gases and even how to make them does not meet the conditions. Gas warfare as it is developing is more sudden, more violent and more unexpected than any other method. The only way to succeed in gas warfare is, first, to be willing to launch it and second, to be in complete readiness. Germany is the only nation equipped to fulfill the second requirement of readiness. Her position in regard to chemical warfare is similar to that of Great Britain's sea power for many years, except for the fact that battleships and cruisers are growing obsolete while aircraft and chemical destructives are still undeveloped.

Well, what of it all? Is Germany going to war again? Herr Stinnes, the late Dr. Rathenau and others have tried to avoid clashes with other nations. The old military crowd and the same old government bureaucrats seem impatient to re-establish the empire, to "lead the world" again. But even so, what of it? Suppose such international arrangements are made: it will aid toward comity if Germans with fevered brows can be kept enough in the background. Suppose, on the other hand, they are not made. The leadership in dye technology enjoyed by the I.G. leaves them still at the head. German works will be able to produce gases in quantity for a strategic surprise just as well as but no better than before. British Dyestuffs will have a long, hard pull to go it alone. The good will of other peoples, so frankly desired by Germany, will be much slower in coming to them.

Whether it is wise or not to make such treaties as have been made by the French and Italian corporations the writer of these lines does not profess to say. The question "Are Germans to be trusted?" like the proposed manufacturing agreement, is in the air. It seems better to us to trust them than to mistrust them—provided the trustor can keep awake and has sharp eyes. But far more important than dye agreements for each nation that would be free and always in a position to defend itself is the intensive study and understanding by her sons of the science of chemistry. Without this knowledge, this understanding, this prescience of what chemistry can do, we shall all be at the mercy of any people that prepares itself adequately and secretly to conquer the world.

Rapid Calculation of Theoretical Maximum Temperatures*

By George Granger Brown
Department of Chemical Engineering, University of Michigan

Four Methods for Computing the Temperature Developed by a Reaction—Graphical, by Trial, Algebraic and Slide Rule Methods Described

To COMPUTE the temperature developed by a chemical reaction, such as the combustion of fuel or detonation of an explosive, the heat available to raise the temperature of the reaction products must equal the thermal capacity of the reaction products. But as the specific heat varies with the temperature, which is unknown, it is necessary either to estimate the temperature for a tentative value of the specific heat and solve by trial, or to use an expression for the mean specific heat or thermal capacity as a function of the temperature and solve the quadratic equation for temperature rise.

The various methods of estimating maximum temperature are best shown by demonstrations. Below are given five different methods of arriving at this figure with relative advantages indicated:

Graphical Method of Damour[1]

In his book Damour applies this method to find the temperature of combustion of a number of industrial fuels. For the present purpose it is sufficient simply to outline the method by a single application to find the temperature of combustion in burning pure carbon with the theoretical amount of cold dry air.

Damour uses a gram mol as a unit and assumes the air to be composed of 4 gram mols of nitrogen to every gram mol of oxygen. This is equivalent to 80 per cent nitrogen and 20 per cent oxygen by volume. It is not necessary to use a gram mol as a unit; a pound mol, a pound, or a cubic foot might be used as well, provided the equivalent values for heats of formation and thermal capacities or heat content are used. He represents the reaction as follows:

$$C + O_2 + 4N_2 \rightarrow CO_2 + 4N_2 + 97{,}600$$

Estimating the final temperature as between 1,800 deg. C. and 2,200 deg. C., he computes the heat content of the products of combustion over this range as follows:

TABLE I—CALCULATED HEATS OF COMBUSTION

Products of Combustion	Thermal Capacities, Cal. above 0 deg. C.[2] 1,800 deg. C.	2,000 deg. C.	2,200 deg. C.
CO_2	27.2	31.8	36.6
$4N_2$	56.8	64.2	71.6
Total	84.0	96.0	108.2

The total thermal capacities at the temperatures taken are plotted as indicated by points *a*, *b*, and *c* in Fig. 1. A smooth curve (*abc*) is then drawn through these points. As 97.6 Cal. from the reaction are available to raise the temperature of the gases, the final temperature will be that temperature at which the gases will have a heat content of 97.6 Cal. and is indicated by the abscissa ($X_1 = 2{,}040$ deg. C.) of the intersection of the ordinate ($Y_1 = 97.6$) with the curve of thermal capacity.

This method requires an estimate of the final temperature and at least three computations of thermal capacities. However, if a number of computations are to be made upon the same reaction such a chart is very convenient, as the same chart serves for all calculations of the same reaction products.

Temperatures by Trial

If pure carbon is burned with 100 per cent excess cold air, the temperature of combustion may be found in the following manner, using more modern values than those given above.

We know that one gram mol of carbon burned to carbon dioxide liberates 97,200 cal. according to the reaction,

$$\underset{12}{C} + \underset{32}{O_2} \rightarrow \underset{44}{CO_2} + 97{,}200 \text{ cal.}$$

97,200 cal. per gram mol of carbon is equivalent to ($97{,}200 \times 1.8$) B.t.u. per pound mol. As the molecular weight of carbon is 12, one pound of carbon burned to carbon dioxide according to the above reaction will liberate

$$\frac{97{,}200 \times 1.8}{12} \text{ or } 14{,}580 \text{ B.t.u.}$$

The above equation also indicates that 12 lb. of carbon requires 32 lb. of oxygen. Then 1 lb. of carbon will require 2.66 lb. or 31.44 cu.ft. of oxygen. 100 per cent excess air will then be 62.88 cu.ft. of oxygen and 236.4 cu.ft of nitrogen, assuming air to be 79 per cent nitrogen by volume

$$1 \text{ lb. } C + 62.88 \text{ cu.ft. } O_2 + 236.4 \text{ cu.ft. } N_2 \rightarrow 31.44 \text{ cu.ft. } CO_2 + 31.44 \text{ cu.ft. } O_2 + 236.4 \text{ cu.ft. } N_2 + 14{,}580 \text{ B.t.u.}$$

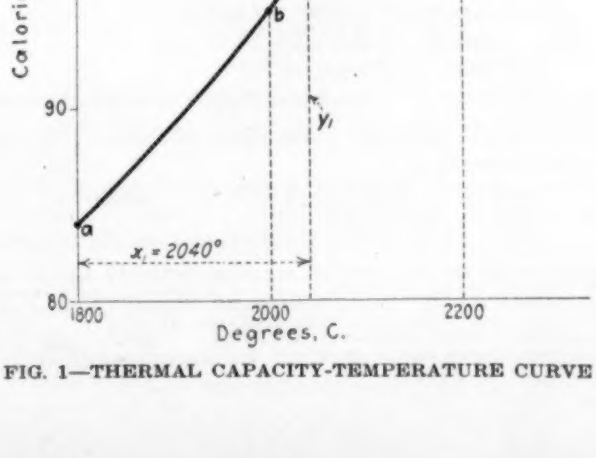


FIG. 1—THERMAL CAPACITY-TEMPERATURE CURVE

*This paper is a revision of one presented at the New York meeting of the American Chemical Society, September, 1921.

[1] Emilio Damour: "Le Chauffage Industriel et les fours a Gas," translated by A. L. J. Queneau, "Industrial Furnaces and Methods of Control," *Eng. Mining J.*, 1906.

[2] Mallard and LeChatelier. *Ann. des mines* (8) 4 (1884), pp. 379 to 559.

If the air is supplied at 60 deg. F., the mean specific heats between 60 deg. F. and t deg. F. are used.[3]

Estimating 2500 deg. F. as the final temperature, the mean specific heat between 60 deg. F. and 2500 deg. F. of the products of combustion may be computed by multiplying the number of cubic feet of each gas by mean specific heat over the required range and adding. That is, (Total mean specific heat) $\times$ (degrees rise) = (heat content) = heat available.

TABLE II—CALCULATION OF MEAN SPECIFIC HEAT

Products of Combustion Gas	Cu.Ft.	Mean C_p[4] (60 to 2,500 deg. F.)	Mean Specific Heat
CO_2	31.44	0.0307	0.967
O_2	31.44	0.0191	0.601
N_2	236.40	0.0191	4.520

Total C_p (60 to 2,500 deg. F.) = 6.088.

Then total $C_p \times (t_2 - t_1)$ = heat available.

or $6.088\ (t_2 - 60) = 14580.$

$(t_2 - 60) = 2400.$

Therefore $t_2 = 2400 + 60$ or 2460 deg. F. which is a satisfactory check with the estimated 2500 deg. F.

The final temperature as calculated must check the temperature estimated for determining the specific heat. Usually a satisfactory check can be obtained in two trials.

This method is satisfactory, providing a table of mean specific heats over the particular range desired is available. Otherwise it becomes necessary to reduce the computations to the datum plane of the initial temperature of the available table and the method loses its advantage.

Algebraic Solution

A method of wide application uses an expression for the mean specific heat in which the temperature occurs as a variable. This leads to a quadratic equation which is solved for the variable—the temperature rise.

This method may be applied to the same computation as above, the combustion of carbon with 100 per cent excess air, using the expression for the mean specific heat instead of a numerical value from the tables. If the mean specific heat is multiplied by the temperature rise, in this case t, the expression for the thermal capacity is obtained, which may be used directly as indicated below.

As above

1 lb. C + 62.88 cu.ft. O_2 + 236.4 cu.ft. $N_2 \rightarrow$
31.44 cu.ft. CO_2 + 31.44 cu.ft. O_2 +
236.4 cu.ft. N_2 + 14580 B.t.u.

TABLE III—CALCULATION OF THERMAL CAPACITY

Products of Combustion Gas	Cu.Ft.	Thermal Capacities[5] (0 deg. to t deg. F.)
CO_2	31.44	$(0.0227t + 0.385t^2\ 10^{-5})$
O_2	31.44	$(0.01786t + 0.883t^2\ 10^{-6})$
N_2	236.4t	$(0.01786t + 0.883t^2\ 10^{-6})$

Total thermal capacity = $5.694t + 0.357t^2\ 10^{-3}$

The thermal capacity must equal the heat available to raise temperature.

Heat content = 14580 = $5.694t + 0.000357t^2$.

[3] A. H. White, Technical Gas and Fuel Analysis. McGraw-Hill, p. 303, 1921.

[4] Mean specific of one cu.ft. of gas measured at 60 deg. F. and 30 in. mercury calculated from equations of Holborn and Henning, *Ann. Physik*, 23, 1907. Uber die spezifische Warme von Stickstoff, Kohlensäure und Wasserdampf bis 1,400 deg. C.

[5] Calculated from values of A. Langen. Mitteilungen über Forschungsarbeiten auf dem Gebiet des Ingenieurwesen Heft 8, 54 S. Berlin, J. Springer, 1903.

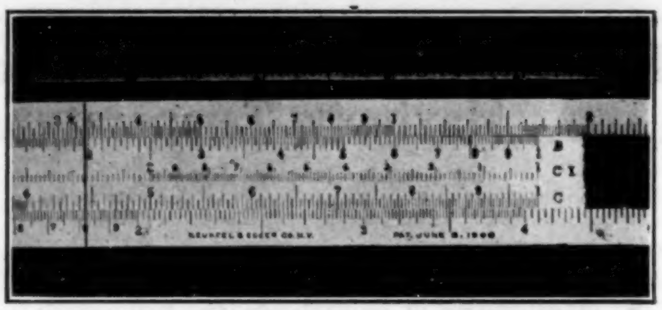


FIG. 2—SLIDE RULE SOLUTION OF QUADRATIC
$t^2 + 15950t - 40{,}890{,}000 = 0$

$$0.000357t^2 + 5.694t - 14580 = 0$$

$$t = \frac{-5.694 + \sqrt{(5.694)^2 + (4 \times 14580 \times 0.000357)}}{2 \times 0.000357}$$

t = 2250 deg. F.

This differs from the solution above, as Langen's values for the specific heat above 0 deg. F. were used instead of Holburn and Henning's above 60 deg. F.

Slide Rule Solution

The quadratic equation obtained above

$$0.000357t^2 + 5.694t - 14580 = 0$$

may be easily reduced to

$$t^2 + 15950t - 40{,}890{,}000 = 0$$

by dividing the equation by the coefficient of t^2. In this form it may be conveniently factored into

$$(t - 2250)\ (t + 18200) = 0$$

on the slide rule, using the CI and D scales, as shown in Fig. 2; 1 on CI being set over the constant term (40,890,000) on D, the product of any coinciding numbers on scales CI and D must equal 40,890,000. The hair glass is adjusted so that the difference between the corresponding values on CI and D equals the value of the coefficient of the t term (15,950). Thus 18,200 — 2,250 = 15,950. The two values so determined, with their signs changed, are the roots of the equation:

$$t = 2{,}250 \text{ or } -18{,}200.$$

Obviously, the positive value only is of interest, so the final temperature is 2250 deg. F. This method is convenient and can be executed rapidly and accurately with a little practice.

Graphical Solution of Quadratic

The same quadratic equation

$$t^2 + 15950t - 40{,}890{,}000 = 0$$

may be very conveniently solved for the positive root by the chart shown in Fig. 3. The constant term (— 40,890,000) is taken along the ordinates and the coefficient of t (15,950) is taken along the abscissas. The intersection of the indicated abscissa and ordinate is on the temperature line corresponding to the solution of the equation in this case midway between 2200 and 2300 or 2250 deg. F. Such a chart is very easy to construct, being made up entirely of straight lines, and may be used for any and all substances or mixtures in any units, English, metric, or otherwise.

The accuracy of any such calculation is limited by the accuracy of the specific heats used. For industrial work the following expressions derived from the work of Pier[6], Bjerrum[7] and Siegel[8] are accurate and very satisfactory.

[6] M. Pier, *Z. Elektrochem.*, vol. 15 (1909), p. 536; vol. 16, p. 517 (1910).

[7] Niels Bjerrum, *Z. Elektrochem.*, vol. 17, p. 731 (1911) and vol. 18 (1912). *Zeit. für Physikalische Chemie*, vol. 79, pp. 513, 537 (1912).

[8] Wilhelm Siegel, *Z. physik. Chem.*, vol. 87, p. 641 (1914).

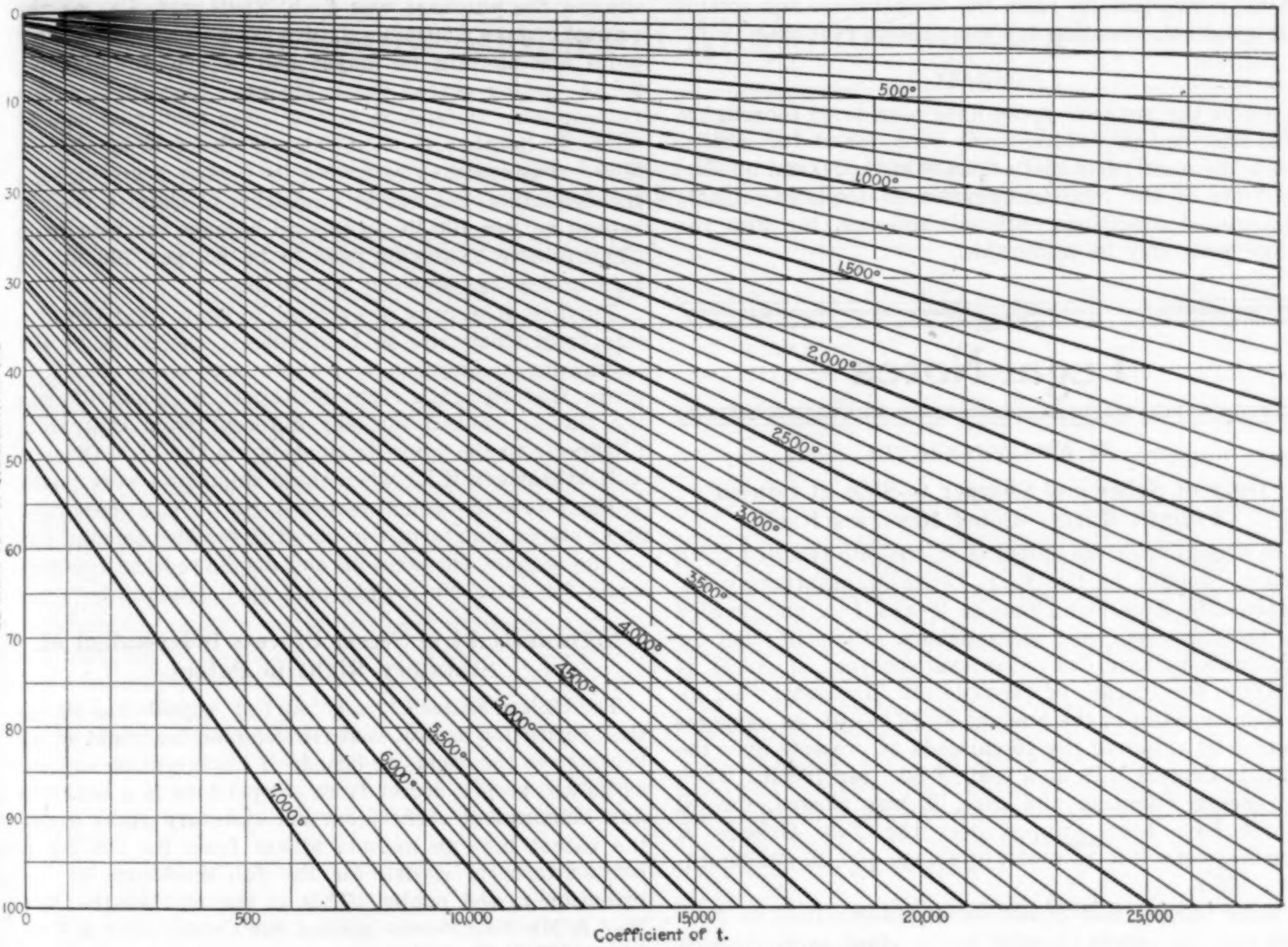


FIG. 3—GRAPHICAL SOLUTION OF QUADRATIC

MEAN C_p (0 TO t DEG. C.) IN CAL. PER GRAM MOL

Diatomic gases (N_2, O_2, CO) = 6.9 + 0.00042t.

CO_2 (up to 1250 deg. C.) = 8.8 + 0.0024t.

CO_2 (above 1250 deg. C.) = 10.02 + 0.00072t.

H_2O = 7.8 + 0.00175t.

MEAN C_p (0 TO t DEG. F.) IN B.T.U. PER POUND MOL

Diatomic = 6.88 + 0.000234t.

CO_2 (up to 2300 deg. F.) = 8.7 + 0.00135t.

CO_2 (above 2300 deg. F.) = 10 + 0.0004t.

H_2O = 7.75 + 0.001t.

MEAN C_p [t TO ($t + x$) DEG. C.] IN CAL. PER GRAM MOL

Diatomic gases = 6.9 + 0.00084t + 0.00042x.

CO_2 (up to 1250 deg. C.) = 8.8 + 0.0048t + 0.0024x.

CO_2 (above 1250 deg. C.) = 10.02 + 0.00144t + 0.00072x.

H_2O = 7.8 + 0.0035t + 0.00175x.

MEAN C_p [t TO ($t + x$) DEG. F.] IN B.T.U. PER POUND MOL

Diatomic gases = 6.88 + 0.000468t + 0.000234x.

CO_2 (up to 2300 deg. F.) = 8.7 + 0.0027t + 0.00135x.

CO_2 (above 2300 deg. F.) = 10 + 0.0008t + 0.0004x.

H_2O = 7.75 + 0.002t + 0.001x.

Any of the expressions given above may be converted to mean C_v over the same temperature range by subtracting 1.985, or more simply 2, from the constant term.

To convert from cal. per gram mol to cal. per gram, or from B.t.u. per pound mol to B.t.u. per pound, divide the entire expression by the molecular weight of the gas.

The above equations for calories per gram mol may be converted to calories per liter, or Calories (kilogram cal.) per cubic meter at 0 deg. C. and 760 mm. by dividing the entire expression by 22.4. The equations for B.t.u. per pound mol may be converted to B.t.u. per cubic foot at 60 deg. F. and 30 in. by dividing the entire expression by 378.

In every case, the thermal capacity or heat content of a gas over a temperature range is equal to the mean specific heat of the gas over that temperature range multiplied by the number of degrees in the temperature range. For example, the heat content of a pound mol of water vapor at constant pressure (C_p) between 1,000 and 3,000 deg. F.:

C_p [t to ($t + x$) deg. F.] = 7.75 + 0.002t + 0.001x

Heat content = 7.75x + 0.002tx + 0.001x^2

Heat content (1000 to 3000 deg. F.) = 7.75 (2000) + 0.002 (1000) (2000) + 0.001 (2000)^2 = 2000 (7.75 + 2 + 2)

Heat content, or thermal capacity at constant pressure (1000 to 3000 deg. F.) = 2000 × 11.75 = 23500 B.t.u.

Similarly the heat content between 1000 and (1000 + x) deg. F. may be computed for water vapor per pound mol from the following:

C_p [1000 to (1000 + x) deg. F.] = 7.75 + 2 + 0.001x

Heat content = 9.75x + 0.001x^2

where x is degrees rise above t deg. F. and may be determined graphically as outlined above by placing this expression for thermal capacity equal to the number

of B.t.u. available to raise the temperature and solving the quadratic equation for the positive root of x.

Summary

All of the methods given have been tried thoroughly. The last two procedures have been found for general work the most rapid and accurate methods, and no close estimate of the final temperature is required. Under the special conditions outlined, however, the first two procedures may be preferable.

Legal Notes

By Wellington Gustin

Duty of Seller and Shipper to Ship at Lowest Freight Rates—Court Reverses Itself

A dispute over the shipping of creosote resulted in an action brought by the F. J. Lewis Manufacturing Co. against the American Creosote Works, Inc., and decided by the Supreme Court of Louisiana. Plaintiff sued for $3,399.25, balance due on an oral contract in excess of $16,000, for 10 cars of creosote oil. Defendant set up a counter-claim in the amount of $3,361.68, as damages caused by shipping the 10 carloads of creosote over the Illinois Central R.R. at a cost of 50c. per 100 lb., when by proper attention and care, it was alleged, the oil might have been shipped over the New Orleans & Northeastern R.R. at a cost of 8c. per 100 lb. (90 Southern, 566.)

Both parties had offices or representatives in New Orleans, La., while plaintiff has a plant at Southport, La., and defendant's plant is at Louisville, Miss. The parties had been doing business together for some time, while plaintiff had a tank at Chalmette, just below New Orleans, and the creosote had been sent over the N. O. & N. R.R., to Louisville, Miss., at a rate of 8c. per 100 lb. from Chalmette. But it abandoned this tank at Chalmette and established a plant in Southport, which also adjoins New Orleans. These three points are in what is called the "New Orleans district." There was some confusion in the evidence as to where the creosote was to be shipped from.

It was shown that the custom of the trade was for the seller to do the shipping, and in this case the shipping was attended to by the plaintiff selling company.

Point of Shipment Uncertain

Plaintiff claimed that the creosote was to be delivered f.o.b. Southport, while defendant claimed that it was to have been delivered f.o.b. Chalmette. Correspondence and the evidence made the point of shipment uncertain, but the Supreme Court on the first appeal held the point to be New Orleans. Further, it held that the plaintiff was negligent in not looking up the published railroad freight rates and shipping to defendant over the best route at the best rates. It said the plaintiff could not select the road which made the greater charge at the expense of defendant whom it was pretending to serve, but that it must bear the loss for this failure and negligence in the part of its manager. Therefore judgment was given for the excess freight rate paid.

However, on a rehearing granted in this case the court found that a certain letter and correspondence showed the purchase was f.o.b. Southport, La., as the creosote, about 250,000 gal., was then in storage at this point and plaintiff no longer had or kept oil at Chalmette, having ceased doing business there before this transaction. Defendant in one letter confirmed sale of oil f.o.b. Southport to be shipped direct to Louisville, Miss. The court, in reversing its former decision, says the defendant was not in a position to claim a freight rate of 8c. per 100 lb. on this oil because the rate from Chalmette to Louisville used to be 8c. per 100 lb., in former dealings between the parties.

Further, there was no evidence to show what the rate was from Chalmette to Louisville at the dates of the shipments in question and there was no evidence to prove that the rate from Southport to Louisville via the Illinois Central was any different from that from Chalmette to the same destination via the New Orleans & Northeastern R.R., when these shipments were made.

Therefore the court reversed its former judgment and entered judgment for plaintiff for the amount due on the account for creosote and disallowed the counter-claim for excessive freight paid by defendant.

Natural Right in Secret Process Independent of Statutory Right in Patent

The United States Circuit Court of Appeals has stated the proposition as law, that the common law right of an inventor to the exclusive benefit of his invention so long as he can keep it secret from competitors is a separate and independent right from his statutory right under the patent laws to exclude others from its use for a limited term in return for the full disclosure of his invention to the public. This in the suit by the Nye Tool & Machine Works against the Crown Dies & Tool Co. (276 Fed., 377.)

In an advisory way, the court says that an inventor is not compelled by law to apply for and take out a patent. If he has produced a new composition of matter of such a nature that the ingredients and the process are safe from discovery by others either by observing his use of his invention or by independent investigation and experiment, he would have a much more enduring monopoly by refusing to make the "full disclosure" that our patent statute invites. Such is his natural or common law right. One seeks a patent only when he fears others may discover his invention and exercise their common law right to copy and use the same. So, as the court points out, the common law right and statutory right are separate and independent, neither infringing upon the other. Whether an inventor exercises or refuses to exercise his natural or common law right has nothing to do with his assertion of his statutory right, which consists exclusively of his power, through the courts, to restrain others from practicing his invention and to call them to account for having done so in defiance of his monopoly granted by the patent statute. This view of our patent system has been established in Supreme Court opinions. (97 U. S., 501; 210 U. S., 405.)

From another angle in this case the defendant contended that a patent could be assigned only as an entirety. But section 4898 of the U. S. Revised Statutes says that "any patent, or any interest therein, shall be assignable in law by an instrument in writing." The court said that the words "any interest therein" gives the patentee the right to subdivide and deed or lease his property as he pleases.

Notes on Aluminum Alloys for Casting*

Useful Foundry Alloys Contain Relatively Low Percentages of Copper, Zinc or Both — Other Metals Are Alloyed in Smaller Percentages—Physical Properties of Aluminum Alloys Used in America and Other Common Metals and Alloys Are Tabulated

THE two principal alloying ingredients of aluminum casting alloys at the present time are copper and zinc, usually taking the form of aluminum-copper or aluminum-zinc-copper alloys. Manganese and magnesium are frequently used. Nickel, chromium, tin and other metals have been alloyed with aluminum with varying degrees of success.

When commercially pure aluminum is alloyed with one or more of the common metals, the usual effects are an increase in the tensile strength and hardness, a reduction in the shrinkage and an improvement in the machining qualities of the metal.

Increased tensile strength and hardness are not always accompanied by a decrease in the elongation. However, there is usually a decrease in elongation when the increase in strength and hardness is caused by a change in the chemical composition of the alloy; but any change in the casting conditions which increase the tensile strength of an alloy also increases the elongation; hence there is a double gain of tensile strength and ductility.

What is true of alloying aluminum with small quantities of other metals is also generally true when other metals are alloyed with small amounts of aluminum. When this is done the good effects, as in the previous case, at first predominate, but the tendency for the ductility to decrease is present and it increases as the amount of aluminum increases.

Aluminum-Copper Alloys

All the useful alloys of the aluminum-copper series may be placed in one or the other of the two classes: Those containing less than 15 per cent copper, and those containing less than 11 per cent aluminum. The first class embraces the alloys most applicable to general casting purposes in the aluminum industry. Because of the nature of their constituents, alloys of this class are not subject to burning in the foundry, as are alloys containing more volatile metals.

The copper content in this series of alloys is now fairly well standardized. After years of experimentation and commercial practice in which almost every combination of aluminum and copper has been tried, trade sentiment has gradually crystallized in favor of an alloy containing from 7.0 to 8.5 per cent copper. This amount of copper produces a tough alloy the tensile strength of which will vary from 15,000 to 20,000 lb. per square inch, depending upon the casting conditions. It casts well and gives little trouble from checking and drawing of the casting, and is the one most generally used for all-round aluminum casting work. It is commonly known as No. 12 Alloy and will be discussed in detail later.

Alloys containing a higher copper content than this are sometimes used in the United States for castings which are to be subjected to high temperatures, water or steam pressure. A high-copper alloy is frequently used in the die-casting industry because of its relatively low shrinkage. Castings made from such alloys may fail if subjected to repeated shocks and stresses.

Alloys of the second class, containing less than 11 per cent aluminum, are known as aluminum bronzes. The aluminum content usually ranges from 1 to 10 per cent, that containing 10 per cent aluminum probably being most popular. A greater amount makes the metal hard and brittle, for the effect of aluminum is very similar to that of copper in the light alloys of aluminum. The tensile strength of aluminum bronzes is high, and ranges from 80,000 to 110,000 lb. per square inch. These bronzes do not corrode readily, and have a great resistance to alternating stresses, being superior to some steels in this respect.

Intermediate alloys of the aluminum-copper series, ranging from 15 to 90 per cent of copper, give crystalline and brittle grayish-white alloys of no use. After about 80 per cent of copper is reached the red color of the copper begins to show.

Aluminum-Zinc Alloys

The useful alloys of the aluminum-zinc series may, like those of aluminum and copper, be divided into two classes: Those containing less than 33 per cent zinc, and those containing a relatively small amount of aluminum.

Zinc produces a very strong alloy with aluminum, the tensile strength running as high as 38,000 lb. per square inch for the alloy consisting of 50 per cent zinc and 50 per cent aluminum. Such an alloy, however, is excessively brittle. The decrease in ductility of these alloys as the zinc content increases places the maximum of zinc at 33 per cent, and even this is much too high if the casting is expected to withstand stresses. The best aluminum-zinc alloys usually possess considerably less zinc than this. Zinc tends to give additional fluidity to aluminum, and produces sharp and sound castings when skillfully cast.

For forging, few metals excel an alloy containing from 10 to 15 per cent zinc. This alloy is tough, flows well under the forging dies and produces a finished product which is solid, easily machined and remarkably strong per unit of area. Castings made from aluminum-zinc alloys machine well, and the machining qualities improve with aging of the metal.

Alloys of this class seem to be unusually sensitive to irregularities in the casting process. If the metal is overheated there is danger that the zinc may be burned out. In addition, these alloys are more subject to drawing in heavy parts or lugs than are the copper alloys. This tendency, however, can in most cases be overcome by proper gating, suitable chills and risers, and adequate temperature control. Zinc alloys are unusually sensitive to high temperatures, and therefore can-

*From sales department condensed data prepared by the Technical Department, Aluminum Company of America.

not be used where the casting will be subjected to considerable heat. A casting made from a 25 per cent zinc alloy when raised to a temperature of 100 deg. C. loses one-third of the tensile strength it possessed at 20 deg. C. Zinc alloys have never been very popular in the United States. Doubt in the minds of many as to their freedom from deterioration with age has probably had much to do with their limited use.

Alloys in the second class of the aluminum-zinc series, those composed of relatively small amounts of aluminum, are known as aluminized zinc. The aluminum content is usually 5 or 10 per cent. These alloys are used in zinc-galvanizing baths to make the bath more fluid and to clear it of oxides, and in the manufacture of aluminum brass, but they are never used directly as are the aluminum-zinc casting alloys.

Aluminum-Zinc-Copper a Favorite Alloy

As previously stated, an alloy of aluminum and zinc has never been very popular in the United States. Where zinc is used the trade favors the addition of small quantities of copper. Copper increases the tensile strength, improves the casting qualities and gives greater rigidity to the aluminum-zinc alloy. In England an alloy composed of 13 per cent zinc and 3 per cent copper is used quite extensively. In the United States an alloy containing 15 per cent zinc and 3 per cent copper finds most favor, and is known to the trade as No. 31 Alloy. These alloys, either with or without the addition of copper, have never been as popular in the United States as they are in Europe.

In general, manganese influences aluminum in much the same manner as copper, renders it first both harder and stronger but less ductile, and subsequently decreases the strength as well as the ductility. Manganese alloys are very resistent to corrosion, being superior to the pure aluminum in this respect, the resistance increasing with increase in the manganese content. These alloys are most frequently rolled into sheets, but as 1½ and 2 per cent manganese alloys are dense and close grained, they are not infrequently used for casting small parts, such as pipe fittings, which are to be subjected to water or steam pressure.

Alloys of magnesium with aluminum are usually known as magnalium. Because of the great affinity of magnesium for oxygen, these alloys tend to form considerable dross on remelting unless the magnesium content is low. As a result, it is not generally good practice to add more than 5 per cent magnesium. Most alloys possess even less than this amount, and few commercial alloys carry over 2 per cent magnesium.

Magnesium alloys are harder, stronger and lighter than pure aluminum. Their tensile strength is practically equal to that of No. 12 Alloy, and their elongation is greater. Magnesium tends to make the mixture more fluid at low temperatures.

Magnesium may be introduced in the following manner: The pure magnesium is held in a pair of iron tongs and pushed slowly to the bottom of the crucible after it has been removed from the fire, or in the ladle just before pouring. It must be stirred slowly until the magnesium has completely melted from the tongs as determined by the sense of touch. The magnesium should be added in small amounts. If a long stick is pushed into the crucible it may break and the broken pieces float to the surface, where they will catch fire before they are melted, taking oxygen from the air instead of from the aluminum or the dissolved gases. After sufficient magnesium has been added more vigorous stirring should be continued for a short time in order to give the oxide of magnesium a chance to float to the surface. Then it should be poured and skimmed in the usual way. No other flux is necessary. Care should be taken to see that the tongs and magnesium are dry, to eliminate violent action and danger in introducing the magnesium.

Other Alloys Less Useful

Nickel is sometimes used as a hardener for aluminum, and produces practically the same effect as copper. However, nickel costs more than copper, and it has been found very difficult to make the nickel-rich alloy for incorporating the nickel in the melts. The nickel content should never exceed 5 per cent, for a 5 per cent alloy develops practically the full tensile strength that can be obtained without decreasing the elongation to such an extent that the casting would be unsuitable for commercial foundry work.

Small proportions of tin are sometimes advantageously used with aluminum to give greater strength and rigidity to heavy castings as well as to reduce the shrinkage of the metal. Tin also serves to give sharpness to the outline of the casting. The tendency, however, to reduce the elongation to the point of impracticability prevents the general use of tin-aluminum alloys.

No casting alloys of any value are formed by alloying aluminum with iron. A small amount of iron always occurs in aluminum as an impurity, but is only detrimental when it exists in amounts exceeding 1.5 to 2.0 per cent. The effect of more than these percentages of iron is to dangerously reduce the elongation. It also makes the molten metal sluggish, necessitating a higher temperature in the furnace with the consequent tendency toward blow holes and shrinkage cracks in the finished casting.

TABLE I—DENSITIES OF METALS

(Data for aluminum from Research Bureau, A. C. O. A. Remainder of table compiled from Smithsonian physical tables and other sources. Values for 20 deg. C., 68 deg. F.)

	Grams Per Cubic Centimeter	Pounds Per Cubic Foot	Weights of equal Volumes With No. 12 Alloy = 1
Magnesium	1.75	109	0.612
Aluminum (Al, 99.7)	2.70	169	0.944
Aluminum (Al, 99.0)	2.71	169	.....
Aluminum (Al, 98.0)	2.73	170	.....
No. 12 Alloy (Al + Cu. 7.0 to 8.5)	2.84 to 2.87	177 to 179	1.00
No. 31 Alloy	3.0	187	1.05
Zinc	7.1	443	2.48
Iron, gray cast	7.1	443	2.48
Tin	7.3	456	2.55
Manganese	7.4	462	2.59
Soft Steel	7.8	487	2.73
Brass, cast (Cu 70; Zn 30)	8.4	524	2.94
Bronze, cast (Cu 80; Sn 20)	8.7	543	3.04
Nickel	8.8	549	3.08
Copper	8.9	556	3.11
Lead	11.3	705	3.95

Silicon in the ordinary casting alloys hardens the metal, reduces elongation and affects adversely the machining qualities when it occurs in too large quantities. Care should always be taken to keep the silicon content low, not exceeding 1.0 to 1.5 per cent.

The density of a metal is subject to variation from changes in both composition and structure. For this reason the values which are given in various books are frequently conflicting because the exact composition and structure are not stated. In general an attempt has been made in Table I to select values which are representative for the metals listed. In the case of aluminum and No. 12 alloy the values hold for dense castings. If the castings are somewhat porous they will have cor-

TABLE II—MODULI OF ELASTICITY

Metals	Lb. Per Sq.In.
Lead	2,500,000
Aluminum	9,000,000
No. 12 Alloy	10,000,000
Cast Iron (gray)	12,000,000 to 14,000,000
Soft steel	30,000,000

TABLE III—TENSILE STRENGTHS

Metal	Tensile Strength Lb. per Sq.In.
Pure aluminum, cast	12,000 to 14,000
No. 12 Alloy	18,000
No. 31 Alloy	25,000
Cast brass (Cu 70 Zn 30)	40,000
Cast bronze (Cu 80 Sn 20)	32,000
Cast iron (gray)	25,000
Cast steel (soft)	60,000
Cast copper (electrolytic)	25,000
Cast zinc	4,000 to 12,00

TABLE IV—RELATIVE THERMAL CONDUCTIVITIES AT 100 DEG. C. (212 DEG. F.)
(Compiled from Smithsonian Physical Tables)

Silver	100	Tin	14
Copper	91	Iron, wrought	14
Gold	71	Iron, cast	11
Aluminum	51	Steel, soft	11
No. 12 Alloy	40	Steel, hard	6
Magnesium	38	Lead	8
Zinc	26	Graphite	4

TABLE V—LINEAR THERMAL EXPANSIVITIES
Average Expansion Coefficient, 0 to 100 deg. C. (32 to 212 deg. F.)
(Compiled mainly from Smithsonian Physical Tables)

	Per Degree Fahrenheit	Per Degree Centigrade
Zinc	0.000017	0.000030
Lead	0.000016	0.000028
Magnesium	0.000015	0.000027
Aluminum	0.000013	0.000024
No. 12 Alloy	0.000013	0.000023
Tin	0.000013	0.000023
Cast brass (Cu 71; Zn 29)	0.000011	0.000019
Copper	0.0000095	0.000017
Nickel	0.0000078	0.000014
Cast steel	0.0000067	0.000012
Cast iron	0.0000056	0.000010
Invar steel	0.0000006	0.000001

respondingly lower densities, while if the impurities present are greater, the density may be increased somewhat.

The thermal conductivity of aluminum is relatively high and this property makes the use of aluminum particularly advantageous in the construction of water-jacket walls, oil-pans and other motor parts which it is desirable to keep cool. Table IV lists some of the metals in the order of their relative thermal conductivity.

It is important to know the thermal expansion of a metal when it is to be used for castings such as automobile pistons, which are subject to considerable variation in temperature. The linear thermal expansivity of aluminum is intermediate between that of zinc and brass or copper, and about twice that of iron and steel. Table V shows the linear thermal expansivity per degree for unit of length of various metals. The volume expansion coefficient may be taken as three times the linear expansion coefficient.

The shrinkage of a metal is the linear contraction in cooling from the melting point to room temperature and determines the allowance the patternmaker must use in order to obtain a finished casting of the correct size. The shrinkage of aluminum alloys is somewhat greater than that of cast iron but less than that of steel. (See Table VI.

The purest aluminum so far obtained melts at a temperature of 658.7 deg. C. or 1217.7 deg. F. as shown in Table VII. The commercial grades of metal melt at somewhat lower temperatures. Aluminum has the relatively high boiling point of about 1,800 deg. C. and is not appreciably volatile under ordinary conditions at temperatures below 1,000 deg. C. It is not good practice, however, in making castings of aluminum to heat the metal much above its melting point or to allow it to remain molten for a great length of time.

Alloys differ from pure metals in that they do not melt at constant temperature but over a certain temperature interval. Alloys of eutectic composition are an exception to this rule and melt at constant temperature. The eutectic or lowest melting alloy of the copper-aluminum series contains 32 per cent copper and melts at 540 deg. C. (1,004 deg. F.). No. 12 alloy contains 8 per cent copper; it begins to melt at 540 deg. C. and is completely molten at 636 deg. C. (1,177 deg. F.).

The specific heat of aluminum is 0.21 at room temperature. This means that the quantity of heat that would raise the temperature of a given weight of aluminum through one degree, would raise the temperature of the same weight of water through 0.21 of one degree. The specific heat of aluminum increases with rise of temperature and is about 15 per cent greater at 500 deg. C. The mean specific heat in the temperature interval, 20 to 100 deg. C., for a number of metals, is given in Table VIII.

TABLE VI—SHRINKAGES OF METALS
(Inches per foot)

Pure aluminum	0.21	Brass	0.19
No. 12 Alloy	0.18	Gray iron	0.12
No. 31 Alloy	0.18	Steel	0.25

TABLE VII—MELTING POINTS
(These are the values accepted by the Bureau of Standards and given in their Circular No. 35. They hold for samples of the highest obtainable purity; less pure samples will in general have a lower melting point.)

Metal	Degrees Centigrade	Degrees Fahrenheit
Aluminum	658.7	1,217.7
Magnesium	651	1,204
Copper	1,083.0	1,981.4
Manganese	1,230	2,246
Nickel	1,452	2,646
Silicon	1,420	2,588
Iron	1,530	2,786
Zinc	419.4	786.9
Lead	327.4	621.3
Tin	231.9	449.4

TABLE VIII—SPECIFIC HEAT
Mean Specific Heat, 20 to 100 deg. C. (68 to 212 deg. F.)
(Compiled mainly from Smithsonian Physical Tables)

Water	1.000	Zinc	0.093
Magnesium	0.248	Copper	0.093
Aluminum	0.216	Brass	0.09
Cast iron	0.12	Tin	0.055
Manganese	0.121	Lead	0.031
Nickel	0.109		

The electrical conductivity of pure aluminum is 61 per cent of that of copper. No. 12 alloy has an electrical conductivity only about 32 per cent of the conductivity of copper. Alloys have been developed which have conductivities less than 20 per cent of that of copper and which have temperature coefficients of resistivity less than half that of pure aluminum.

Strengthening Springs by Overstrain

It is a known experimental fact that if a metal is loaded somewhat beyond the limit of proportionality, the load then released and then retested, the limit of proportionality will be found at a higher stress than originally. However, it is not so well known that this obscure physical phenomenon has long been applied in industry.

In manufacturing helical springs, these are first of all coiled to a height considerably above their finished height, then hardened and tempered. Then they are compressed to the limit, which overstresses the metal beyond its yield point, and the spring acquires a slight permanent set, so that upon removal of the load the spring returns only as far as the designed height. This has always been done to lift the elastic limit, so as to have the advantage of the greater strength thus induced.

Temperature-Pressure Curves of Petroleum Products

By M. B. Cooke
Assistant Refinery Engineer, Bureau of Mines

In the course of investigations now in progress by the Bureau of Mines into the nature of "gum forming" constituents of gasoline, several gasolines and other petroleum products were heated in a small bomb and pressures of considerable magnitude were developed. As the bureau has received many inquiries for data showing the pressure that may be developed in a still when gasoline or other oil is subjected to elevated temperatures, it was thought advisable to record the pressures observed at various temperatures in the course of this work. These data were merely a byproduct of the main investigation.

Gasoline and similar products are very complex mixtures and it is difficult to determine accurately the true vapor pressures; hence the vapor pressures of the oils used in these tests have not been studied in detail, but the data obtained may be taken as representative of the pressure-temperature relations of the various oils in commercial work.

Apparatus and Procedure

The apparatus for the tests consisted of a small steel bomb designed to carry a working load of 1,000 lb. per sq.in. with a factor of safety of 20. This bomb was constructed from a hexagonal piece of steel bar, and the outside dimensions without the cover were about 2½x6 in. The lid was made in one piece from the same material, was ⅝ in. in thickness, and was threaded on the inside of the rim. The bomb proper had inside dimensions of 1½x5⅜ in. and was threaded on the outside of the rim. The lid was also provided with a male rim which fitted into a groove, containing a lead gasket, machined in the top of the bomb. A pressure gage mounted on a ⅜x6-in. brass nipple of ⅛-in. bore was screwed into a hole in the center of the lid. The total capacity of the bomb and gage connections was 160 c.c. The bomb was heated in a bath of steam cylinder oil which was stirred thoroughly.

The apparatus was tested by placing in it 100 c.c. of distilled water, closing the bomb, and heating it in the oil bath to a maximum temperature of 200 deg. C. At intervals during the test the temperature of the oil and the pressures developed in the bomb were simultaneously recorded. These results are given in Table I together with data taken from the work of Marks and Davis.[1]

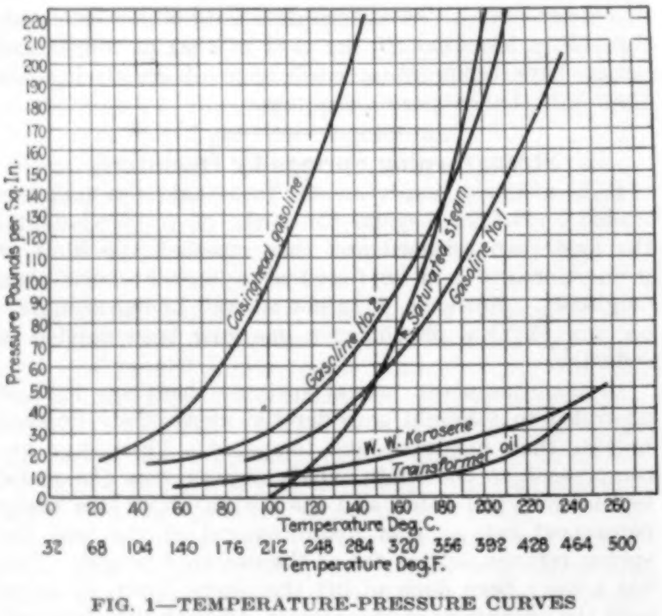


FIG. 1—TEMPERATURE-PRESSURE CURVES

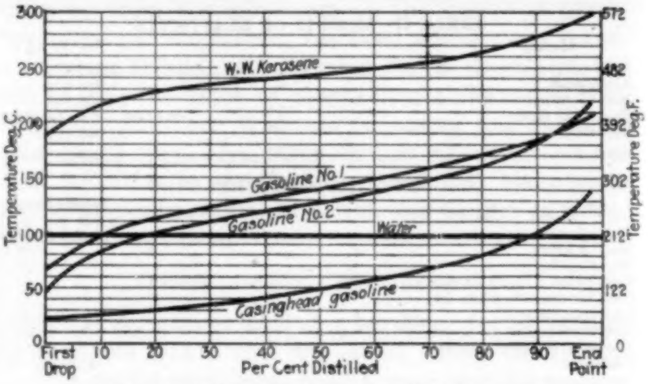


FIG. 2—DISTILLATION RANGE CURVES

TABLE I—COMPARISON OF PRESSURE EXERTED BY 100 c.c. WATER IN BOMB AND THEORETICAL PRESSURES

Temperature of Oil in Bath Deg. C.	Deg. F.	Pressure, Lb. Per Sq.In. (Gage)	Pressure, Saturated Steam (Marks and Davis Tables)
160.0	320.0	70	73
181.0	358.0	130	133
190.0	374.0	163	167
193.0	379.0	175	179
198.0	388.0	200	202

In comparing the results actually obtained in these experiments with data taken from the tables, it will be noted that the maximum error (probably due to the presence of air in the bomb) was 4 lb. per sq.in. It can be assumed therefore that the determinations on gasoline represent fairly closely the pressures that would be developed under theoretically perfect conditions.

Temperatures and pressures were recorded also as the bomb cooled down and showed that the lag between the oil bath and the bomb was probably not more than 1 deg. C.

Discussion of Data

One sample of casinghead gasoline, two of motor gasoline, one of kerosene, and one of transformer oil were heated in the bomb as described above and the resulting temperature-pressure curves for the various products are given in Fig. 1. The distillation range as determined by the standard A.S.T.M. method[2] is given in Fig. 2. The distillation range of transformer oil is not given because it is too high to obtain by the standard A.S.T.M. method.

It will be noted by referring to the curves in Fig. 1 that petroleum products with a low boiling range, such as casinghead gasoline and some of the lighter motor gasolines, generate a higher pressure at a given temperature than water vapor. Petroleum products with a relatively high boiling range, such as kerosene and transformer oil, generate less pressure than water vapor at a given temperature. In general, the pressure generated by petroleum products when subjected to elevated temperatures varies inversely with the average boiling point of the product. The temperature-pressure curves, however, are not parallel, due to the varying composition of the products. For the same reason, the distillation range curves are not parallel.

[1]Lionel S. Marks and Harvey Davis, "Tables and Diagrams of the Thermal Properties of Saturated and Superheated Steam," 1919.

[2]"Specifications Committee Methods for Testing Petroleum Products," Tech. Paper 298, Bureau of Mines, 1922, p. 13.

Manufacture of Fireclay Refractories

Outline of Plant Operations at the Evens & Howard Fire Brick Co., St. Louis—Forming Brick and Special Shapes—Drying—Burning—Manufacturing Operations Co-ordinated to Obtain Maximum Production Efficiency

BY ALAN G. WIKOFF

ST. LOUIS has long been an important center of the fireclay refractory industry because of the exceptional quality of the plastic fireclay in the famous Cheltenham seam underlying the city and county of St. Louis. This clay is refractory enough for many industrial purposes, but the increasing use of very high temperatures has created a demand for more highly refractory products, which has been met by the addition of non-plastic flint clay. Fortunately deposits of excellent flint clay are abundant in the east-central portion of Missouri. But the present plants are no longer able to obtain their entire raw material supply right at their doors, as was the case in the earlier days. Manufacturing methods have also kept pace with the development in service requirements for refractories so that the modern plants make full use of such factors as scientific control and material-handling equipment in obtaining efficient production.

PLANT LAYOUT FOR STRAIGHT-LINE FLOW

Situated in the rolling country just west of St. Louis is the modern firebrick plant of the Evens & Howard Fire Brick Co. The straight line flow from storage pile to stock shed and loading platform is evident from the layout as shown in Fig. 1. The spur from the St. Louis Belt & Terminal R.R. which passes the boiler house, clay shed and calcine kiln is an elevated or high line so that hopper-bottom cars can be dumped directly from it. The clay products are formed and dried in the large 4-story brick building connecting with the clay shed, burned in the kilns which are numbered as shown and then transferred to the stock shed or directly to cars.

As a brick 9x4½x2½ in. is the standard size, plant capacities in this industry are often stated in terms of 9-in. brick, other sizes and shapes being calculated to their equivalents in 9-in. brick. On this basis the daily capacity of this plant is about 115,000 9-in. equivalents, or, roughly, 400 tons, since a 9-in. brick weighs 7 lb.

RAW MATERIALS

As has been indicated, two types of clay form the primary raw materials—Cheltenham plastic fireclay and flint clay.

At the present time the Cheltenham clay is obtained from mines owned by the company, about 5 miles north of the plant. Here the clay occurs as a 10-ft. vein about 100 ft. under ground. A shaft is sunk to the proper level and galleries are run into the vein of clay. Fig. 2 is a general view of one of the galleries. At Mine No. 6, which has just been opened, the clay

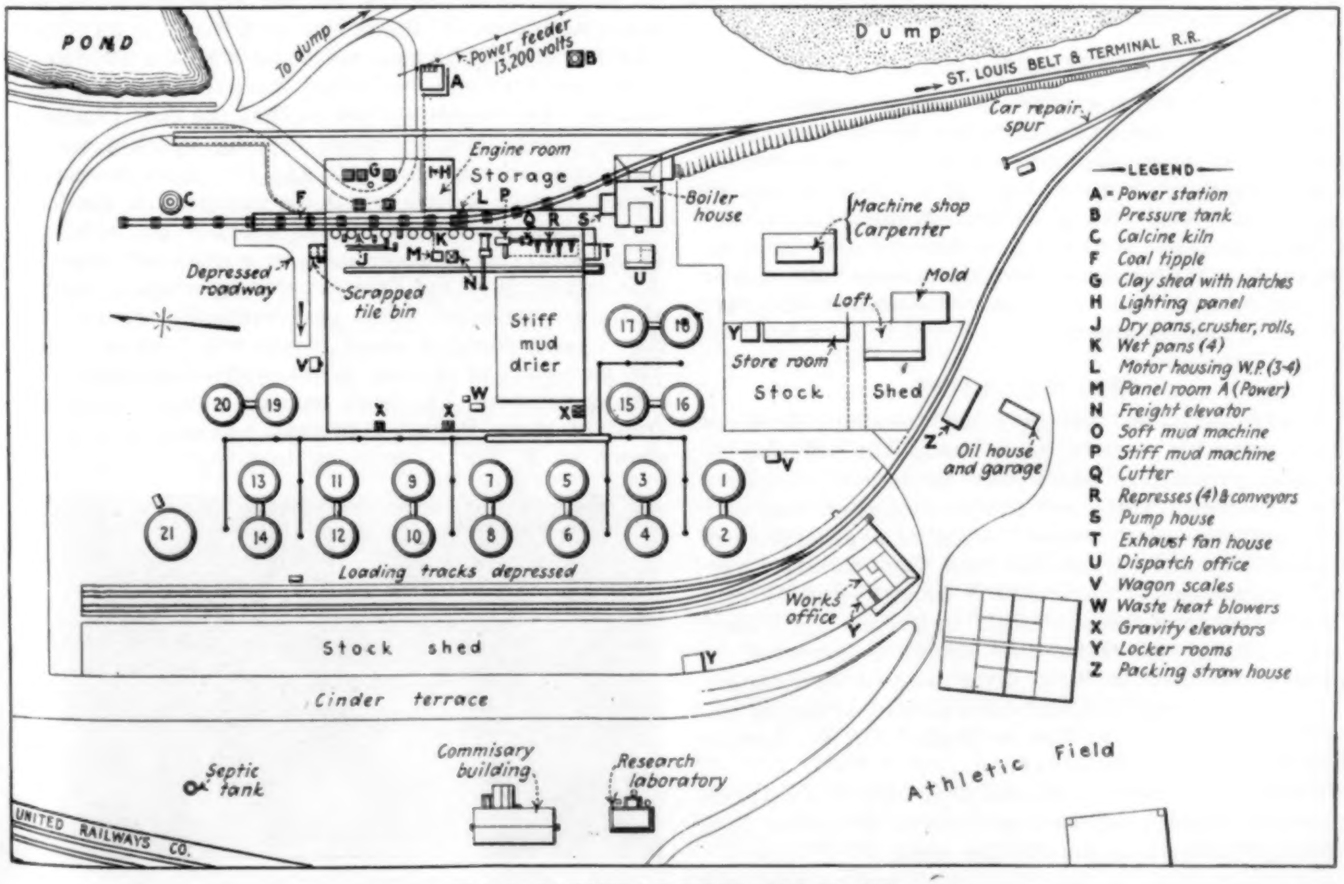


FIG. 1—LAYOUT OF FIREBRICK PLANT

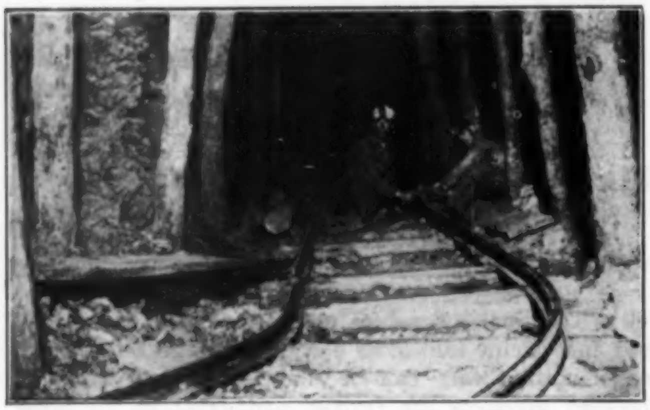


FIG. 2—GALLERY IN A CLAY MINE

loosened by blasting and by pick is loaded upon cars which are hauled to the shaft by a mule, raised by an electric hoist and dumped into elevated storage bins. As yet this mine has not been placed upon a production basis, but it is expected to yield 250 tons a day. The clay from these mines fuses at about Seger cone 31, which is equivalent to 1,750 deg. C., or 3,182 deg. F.

For transporting clay, the company has its own standard-gage hopper-bottom cars.

Flint clay of a grade known as No. 1 white flint is brought from Owensville, Mo., and vicinity, about 100 miles west of St. Louis, where it occurs in pockets in sandstone varying from 100 to 250 ft. in diameter and from 20 to 75 ft. thick. Owing to the fact that the clay has to be hauled from 1 to 5 miles with teams, shipments depend upon fair weather and accordingly it is necessary to provide storage facilities at the plant. If the clay is not used as received it is transferred from cars on the high line to storage piles by an Ohio locomotive crane, which also serves to load hopper-bottom cars when material in storage is to be used.

Grinding Cheltenham and Flint Clays

When ready to be ground, the clay is dumped from hopper-bottom cars on the high line, as shown in Fig. 3, into hoppers which discharge by means of plate feeders into dry pans, *J*, Fig. 1. Each of the three Frost dry pans is provided with a bucket elevator to carry the ground material to the upper floor of the building, where it is screened over sloping screens into master storage bins. Flint clay and Cheltenham clay are ground and stored separately.

Grog and Calcine

In addition to the raw clays just described, there are three materials derived from them, but differing in physical properties, which may be termed secondary raw materials. These are plastic clay grog, flint clay grog and flint clay calcine. Grog is a general term applied to material which has been reground after having been burned. Thus broken or imperfect plastic clay brick taken from the kiln might be ground up to form plastic clay grog. Flint clay calcine is prepared by burning the clay in lump form without preliminary grinding in a vertical shaft kiln located alongside the outer end of the high line so that it can be charged directly from the cars.

Grogs and calcine are ground separately in an Austin gyratory crusher, screened and stored in master bins similar to those used for the raw clays.

There are thus five materials which may be used in a variety of combinations according to the properties desired in the finished product. About twenty-five standard mixes are regularly employed at this plant in the production of a wide range of refractories.

Having the five ground materials in separate bins makes the preparation of any desired mix an extremely simple matter. Freese feeders in the bottom of each master bin are so calibrated that a constant, predetermined flow of material can be delivered from any number of the bins onto a common belt conveyor which runs along one side of the bins. A bucket elevator and another belt conveyor serve to place the mixture thus formed in bins located directly over the machines which are to temper the clay with water. With this arrangement, the proportions of a mixture can be controlled automatically to within 1 per cent.

Methods of Forming Fireclay Refractories

Fireclay refractories may be formed in any one of several ways. Brick may be made on machines or in hand presses. According to the consistency of the mixture (which depends upon the amount of water present), the process is referred to as soft mud, stiff mud, or dry press. In the dry press process, water is added merely to dampen the clay, when the amount normally present in the clay is not sufficient. All three processes are used at this plant, the proportions being about 20,000 hand press, 20,000 dry press, 60,000 stiff mud and 15,000 hand molded.

Many of refractory shapes are so large or so complicated that they must be molded by hand. As the manufacturing operations in the hand-molding and machine departments differ to quite an extent, they will be treated separately.

Machine-Made Firebrick

Clay mixtures for use on the brick machines are mixed with water to the proper consistency in an American pug mill, which consists essentially of a number of blades mounted on a horizontal shaft rotating in a steel trough. The blades are set so that the clay gradually moves toward the discharge opening which feeds an American auger machine (*P*, Fig. 1). Here the clay is forced through a rectangular die emerging in the form of a dense, continuous column about 9 in. wide and 4½ in. thick. As it moves along on a small belt conveyor it is picked up by the Freese cutter, *Q*, where a number of tightly stretched wires pass vertically through the clay column forming about twenty-five brick at a cut. The movement of the clay is not interrupted during the cutting process. The brick pass on a belt conveyor in front of three Bonnot represses. (The fourth press shown at *R*, Fig. 1, is being installed.) At each of

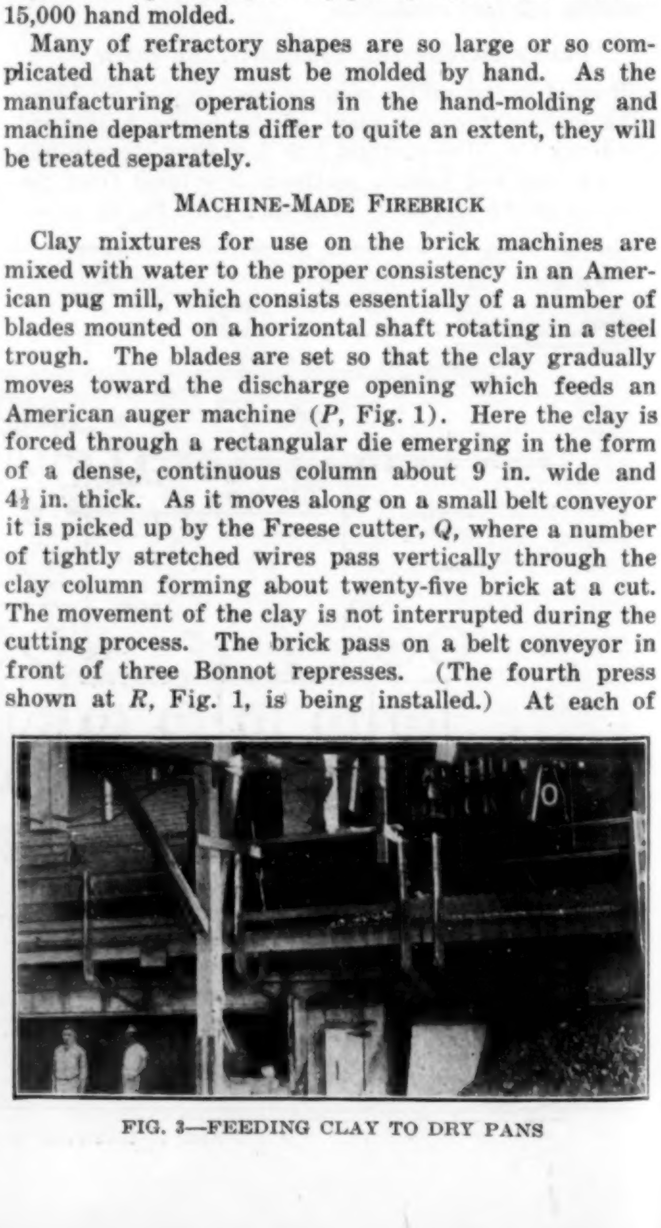


FIG. 3—FEEDING CLAY TO DRY PANS

these, an attendant removes two brick at a time from the conveyor and places them in the press. This operation assures smooth sides and sharp, straight edges so that the brick are easily laid up. Brick made in this way are known as wire side-cut, repressed. This machine has a capacity of 60,000 9-in. equivalents.

Waste Heat Driers

As they come from the presses, the brick are stacked on double deck cars with galvanized truck frames. They are spaced with some degree of regularity so that drying will be as uniform as possible. Waste heat from the kilns which are cooling is supplied to a parallel row of tunnel driers by means of a powerful blower. A transfer car running on a track along the front of the driers makes it possible to place the cars of green brick in any one of the driers. The cars are pulled through by a steel cable attached to an electric winch, three cars of dried brick being drawn at a time. The waste heat driers were installed by the L. E. Rodgers Engineering Co., Chicago.

Since there is always the possibility of not having sufficient kilns cooling at a given time to maintain the proper temperature in the driers, an auxiliary furnace is provided to take care of such emergencies, but this has never been required to date.

All products being burned in the same type of kiln, the general subject of burning will be considered after discussing briefly the production of hand-made ware.

Preparing Clay for Hand-Made Ware

Instead of being put through a pug mill, all clay for hand-made ware is tempered with water in a wet mill. There are four 9-ft. Frost wet pans, *K*, with 14-in. mullers, so arranged under the storage bins that each pan is served by two bins. The pans are elevated so that mud carts can be run underneath to receive the clay as discharged by a Wynn unloader. The mud carts distribute the clay to the molding gangs on the upper floors of the building.

Hand-Made Brick

Each hand-press for making brick is operated by a gang of four men. A wad of clay somewhat larger than the brick to be made is worked into a shape approximately that of the mold and is then thrown with considerable force and skill so as to fill the mold completely and uniformly. After the excess clay has been removed, the press is operated by hand and the brick removed ready for drying. This process is used for the more refractory grades of firebrick, and the five hand presses (made by George Carnell, Philadelphia) have a daily capacity of about 20,000 9-in. equivalents.

FIG. 4—GENERAL VIEW OF KILN YARD

FIG. 5—NORTH END OF KILN YARD

Although the standard brick with its modifications, such as key, wedge, neck, arch, skew and circle, is applicable in a wide range of refractory construction, there are many cases where more satisfactory results can be obtained by the use of special shapes. Many of these are very complicated and their successful manufacture calls for great ingenuity, skill and experience.

Wooden molds are used wherever possible, although some of the larger pieces are built up patiently by hand. Having dusted the mold with fine sand so that the clay will not stick, the molder throws in a lump of clay. After working this uniformly into all parts of the mold, the excess is removed by passing a tightly stretched wire across the free surface of the mold and the piece is carefully removed from the mold and placed upon the floor to dry. The time the ware must remain on the drying floor depends upon the size and shape of the pieces and is determined largely by experience.

By far the larger part of the floor space of the main building is required for the drying floors, as the nine tile gangs (two men each) produce about 15,000 9-in. equivalents per day.

Burning

All ware is burned in round, down-draft periodic kilns, there being twenty 36-ft. kilns each capable of holding 70,000 9-in. equivalents and one 40-ft. kiln with a capacity of 130,000 9-in. equivalents. Figs. 4 and 5 are general views of the kiln yard. A system of tracks makes it possible to bring the cars of brick directly from the driers to the kilns. A loaded car en route to the kiln may be seen in the lower part of Fig. 5. Hand ware is loaded onto two-wheel spring carts, lowered to the yard level by gravity elevators.

Setting the ware in the kiln is an operation which calls for a great deal of experience. Since practically all of the special shapes are incapable of supporting other brick and tile owing to their peculiar shape, the lower half of the kiln is set with brick, arranged according to a definite plan so that the heat will be distributed as uniformly as possible throughout the setting. The careful arrangement is evident in Fig. 6, which shows a kiln being drawn. The upper part of the kiln is filled with special shapes. Heat from the sixteen fireboxes set in the circumference of the kiln rises inside following the crown and then passes down through the ware and the flues in the kiln bottom to the stack.

The kilns are fired on a definite schedule according to the ware in them. Instruction sheets are prepared each day covering every kiln on fire that day. All kilns have pyrometers, and Seger cones and trial pieces are used to determine the finishing time. During the cooling period, the flue dampers are set so that the heat

goes to the driers instead of up the stack. Spring wheelbarrows holding about seventy brick are used to draw the kilns.

An accurate record is kept of the performance of each kiln, all ware being checked in and out and the results entered along with such data as the temperature schedule, hours burned, coal consumption, etc.

About 16 days are required for the complete cycle of setting, burning, cooling and drawing. The average burning time is 180 hours, while setting and drawing each require about 1½ days with a gang of twelve men.

Fuel and Power

Coal, ordered in hopper-bottom cars, is dumped directly from the high line into a tipple holding 150 tons, from which it is distributed around the yard to the kilns by means of an Autocar truck. Steam for heating the drying floors when necessary is supplied by the boiler house.

Power throughout the plant is electrical, machines being equipped with individual motor drive.

Research Laboratory

The laboratory is equipped to make all standard tests for refractory wares, having a muffle kiln, load furnace and high-temperature furnace in addition to the necessary chemical apparatus. Fig. 7 shows the furnace room, with a glimpse of the laboratory beyond. All clays and finished products are checked up at least once a month, but the most important part of the laboratory work is the development of new products in co-operation with the factory and sales department.

New clays are thoroughly tested before use. The fusion test is, of course, the most important guide to the refractory qualities of the clay, but chemical analysis and load tests are also of value. The regular supply of clay from deposits whose properties have already been determined is inspected at the mine, the flint clay as it is being loaded, and the soft clay by the top level boss.

Functions of Planning Department

Perfect co-ordination of all manufacturing operations is essential if waste of time and materials is to be eliminated in filling orders. Consider, for example, an order for several varieties of special shapes, some small and simple, others large and complicated, all to be delivered at the same time. In such a case, handling would be minimized if all pieces were burned in the same kiln and transferred directly to the freight car. But if the different shapes were manufactured simultaneously, it is obvious that the smaller pieces would be dry before the larger ones and that consequently valuable drying floor space would be wasted.

It is the function of the planning department so to schedule the operations that such wastes are eliminated. This requires an accurate knowledge of the capabilities and limitations of each department and the characteristics of each type of ware. Furthermore, with such data at hand, it becomes possible to promise delivery intelligently. Accordingly, it may be of interest to outline briefly the methods followed in this work.

Analysis of Orders

Orders naturally vary greatly in complexity, from those which call simply for material in stock to those covering a variety of special shapes. If the material is in stock in sufficient quantity the order goes directly

FIG. 6—DRAWING A KILN

to the shipping clerk. If special, it may be of a type which has been made before, in which case the molds will be in stock, or it may be necessary to make new molds. These points having been determined, it is possible to set a delivery date from a knowledge of the standard time required to make, dry and burn that particular type of ware and also of the amount of work already scheduled.

Planning of Making

An order card is made out covering the whole order and separate route cards are made out for each class of ware on the order. This makes it possible to fix the dates for making the different kinds of ware so that all of the order will be ready for setting at the same time. The order card acts as a check to prevent any of the items being overlooked.

When the molds are ready, a molder's order is made out. This gives the making date, the exact amount (including a certain overage to cover possible losses) of war to be made, and the location on the drying floor which experience indicates as the best place for drying that type of ware. When the molding is completed the location on floor is noted on the route card, and an entry made on the order card showing ware made and number of making hours.

Setting

In planning the setting of ware, the kilns are considered as divided into four horizontal zones, the lowest zone being called the first. Experience has shown what zone is best adapted to each type of ware. Thus, some shapes can be set only in the top of the kiln or fourth zone.

All this is considered in preparing the setting schedule, which shows the ware to be set by zones and its location on the drying floor. A kiln near the ware and also convenient to the storage or shipping point should be available if the planning has been carefully done. In addition, the setting of the various kilns should be timed to give as uniform heat as possible to the driers and to prevent loss of time in kiln turnover.

Drawing and Shipping

On the date planned for drawing, the necessary cars are placed as near to the kiln as possible by the yard foreman. From the drawing report, an entry is made on the route cars showing amount drawn and lost. From the shipping ticket, a record of the amount shipped is made on the route cards and if the order is filled, the order card and route card are filed as completed.

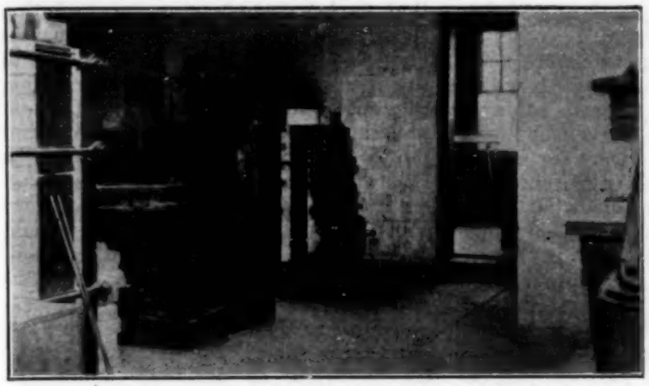


FIG. 7—RESEARCH LABORATORY

Careful inspection at all stages is of vital importance. The thoroughness is indicated in the following brief summary.

All new molds are inspected when completed (and stock molds before using) by the mold inspector. First tile from new molds are examined by the floor inspector, who also makes a daily report of the condition of ware on the drying floor. Before being scheduled for setting, the chief inspector satisfies himself as to the dryness. At the kiln, ware damaged from floor to kiln is rejected by the kiln inspector, who also prepares the drawing report showing quality and loss. All special ware is again inspected by the chief yard inspector for dimensions and quality before being loaded.

While it has not been possible to go into any detail, it is hoped that this discussion will serve to indicate a few of the many factors which have to be considered in directing the manufacture of refractory materials.

In conclusion, the writer wishes to acknowledge the courtesies extended by the management, and to express his indebtedness to A. B. Christopher, ceramic engineer, and J. W. Alexander, of the planning department, for information which was used in the preparation of this article.

Aczol—An Interesting Wood Preservative

MINING engineers and railroad men in this country have expressed a good deal of interest in a new wood preservative—new at least in this country. It had been used in Belgium particularly and on the continent of Europe for a number of years, but has never before been manufactured here.

Its name Aczol is derived from its ingredients—ammonia, copper, zinc and phenol. All of these component parts have been used to a greater or less extent in wood-preserving work. Copper and zinc have been used for a long time and phenol is an essential principle of creosote, which is at the present time the most widely used wood preservative. The novelty of this compound lies in the fact that the inventor has succeeded in producing this mixture in soluble form. It is entirely soluble during impregnation and precipitates after this is completed while the wood is being permitted to dry in the air. The drying causes the evaporation of the ammonia, which in this case simply acts as a carrier of the other material. The phenolic salts of copper and zinc become firmly imbedded in the wood fiber—in fact the sap and ligneous material is soluble in the solution and this liquid is replaced by the precipitated salts.

The impregnation of wood with creosote is accomplished by placing the wood in a large air tight vat. The air is then pumped out to as high a vacuum as possible and the heated creosote is put in under pressure. With Aczol the process can be conducted without the use of vacuum at all. This is, of course, a distinct advantage. It is reported, however, as would be expected, that a better impregnation takes place when vacuum and pressure are used. One distinct point of vantage, however, is the fact that no heat need be used on the solution. This use of heat is thought by some engineers to weaken the wood structure in creosote impregnation. Whether this is the case or not, creosote-impregnated wood is not as strong either in tensile or compressive strength as raw wood and, on the other hand, wood which has been impregnated with Aczol is much stronger, due, in all probability, to the cementing action of the salt in and around the wood fiber.

As compared with creosote, it has a number of advantages. It leaves the wood clean, dry, odorless and fire resisting. This last point is a distinct advantage. Furthermore, the wood can be tooled and worked exactly as untreated wood.

The material is manufactured in rather concentrated form and is diluted—six parts of the product to ninety-four parts of water in the field.

Severe Tests on the Continent

The interesting thing about this product from the standpoint of the American manufacturers is that it has already been tried out. Records of the use of wood impregnated with this material have been kept in Belgium for the past decade. In many coal mines it has been found necessary to renew timber in the return air galleries every 3 or 4 months. This is becoming an increasing expense with the diminution of our forests. When wood was relatively cheap, it did not worry mining engineers much and they said, "Oh well, we would rather put in a new piece than bother with impregnation." Especially was this true when creosote was known to be the best material, for very few persons cared to handle creosote. In Belgium coal mine operators testify that "aczolated" timber has remained in its original sound condition for 8 years. The difference is extremely notable.

Successful as Wood Paving

It has also been used successfully on wood paving. In Brussels during the war, the main street was paved with wood blocks which had been "aczolated." During 1914 the entire German war machinery—millions of soldiers with hobnailed shoes and numberless cannons and supply wagons—passed over these wooden blocks. They are, even now, in perfect condition 10 years after they were placed in use.

In America this product is made by Zinsser & Co., Hastings-on-Hudson, N. Y. No tests, of course, have been made in this country which would compare with the Belgian test, because the material is so new. The company has sample blocks of wood impregnated with this material which have been in mines for 6 or 7 years. Another use of aczolated wood is in railroad ties, where the rotting is extremely rapid, especially in some climates. The development of the use of this product will be watched with a very great deal of interest and it is predicted by a number of competent men that its use will rapidly displace that of creosote or similar work, not only because of its greater durability, but because of its greater ease of handling.

Synopsis of Recent Chemical & Metallurgical Literature

Durability of Sole Leather

Technologic Paper 215 of the Bureau of Standards describes the preparation of four lots of leather used to determine the comparative durability of sole leather filled with sulphite cellulose extract, and sole leather filled with ordinary vegetable tanning materials, such as chestnut wood and quebracho extracts.

Several hides were used in the preparation of each lot, and alternate sides were filled with the sulphite cellulose extract. Each pair of soles contained one sole prepared by each method, both of which were cut from the same hide and from similar locations.

The results of actual service tests are presented, which show that the average wear of the leather filled with sulphite cellulose extract was 9.08 days per unit thickness and of the ordinary leather 9.06 days.

Complete chemical analyses of both the new and worn soles are also given. The general conclusions are that there is no difference in the two leathers as reflected by the chemical analyses, that sole leather filled with sulphite cellulose extract is as durable as leather filled with chestnut wood and quebracho extracts and that the former could well be used in place of the latter materials, thereby conserving them for the actual tanning of leather, for which they are more suitable than sulphite cellulose extract.

Decarburization of Steel by Hydrogen

Charles R. Austin, of University College, Swansea, presented a long memoir on "Hydrogen Decarburization of Carbon Steels With Considerations on Related Phenomena" before the May, 1922, meeting of the British Iron and Steel Institute. He worked with several very pure steels, and examined the metal after 12 hours' exposure to a stream of moist hydrogen at various temperatures. The end result is due to two main factors (*a*) removal of carbon as methane and (*b*) diffusion of carbon from the unaffected core. At low temperatures (*a*) seems to be more important, therefore the line of demarcation between ferrite case and substantially unaltered core is very clearly marked. At high temperatures—roughly above the upper critical—(*b*) is of greater importance, therefore the carbon content decreases gradually.

At temperatures just below A_1 the depth of decarburization was a linear function of the time of exposure. Its actual amount becomes unobservable at about 500 deg. C., but reaches a maximum at about 1,000 deg. C. Measurements and calculations indicate that the amount of carbon diffusing across 1 sq.cm. in one day under unit concentration gradient (i. e., the diffusion constant) is equal to 0.005 at 650 deg. C., and 0.05 at 850 deg. C.

Columnar ferrite crystals were noted in the muffs of steels heated within the transformation range; equiaxed ferrite resulted from higher or lower decarburizations. Tendency for columnarization appeared in hypereutectoid steels at temperatures somewhat above and below this range. No columnar crystals could be developed in Armco iron. Consequently the author concluded that the elongated crystals were caused by the disturbing influence of hydrogen gas diffusing into and out of the steel. There are reasons for believing that this occurs more readily along the grain boundaries.

Growth of Cast Iron

It has long been known that gray cast iron increases in volume after repeated heatings, and the many investigators who have studied the phenomenon have divided into two camps—one which believes it due to internal oxidation, and another which thinks the main influence is the expansion of occluded gases.

Tario Kikuta, in the fifty-ninth report of the Iron and Steel Research Institute (*Science Reports*, Tohoku Imperial University, Sendai, Japan, vol. 11, p. 1) has measured the leakage of gas through the walls of a gray cast-iron tube at various temperatures, and finds that at room temperatures the leakage increases for sixty repeated heatings to 960 deg. C. Furthermore the leakage at elevated temperature is only slightly less than when cold. Therefore the view is untenable that air penetrates the iron at low temperatures, but cannot escape at high temperatures, and hence causes expansion of the iron. Density of a gray cast iron was also observed during repeated heatings under various circumstances. The greatest expansion was noted after repeated heatings *in vacuo*, followed by quenchings. Next was after heatings in air, followed by furnace coolings; air heatings followed by quenchings caused slightly less. The least expansion resulted from heatings and furnace coolings *in vacuo*.

Most instructive data were had by recording temperature-elongation curves. When working *in vacuo*, a large and sudden expansion occurred in gray cast iron during the first heating at 700 to 800 deg. C., caused chiefly by decomposition of cementite (a phenomenon which causes an extension of 2.5 per cent in white cast iron passing through this range). A slight contraction occurs when passing Ac_1, representing the solution of a certain amount of free carbon. This contraction approaches zero at about the fifteenth heating. On cooling, a larger and irreversible expansion occurs at Ar_1, an expansion which recurs with but slightly decreasing intensity on each cooling.

Oxidation can have little to do with this phenomenon, since the work was done in a vacuum. The author thinks that carbon, which goes into solution readily at the eutectoid areas, passes very slowly from the graphite flakes to the surrounding ferrite. On cooling, the eutectoid decomposes readily, expanding and splitting the surrounding ferrite low in carbon. Growth of these fractures occurs by repeated stresses during cooling, and consequently growth continues. Slow cooling should permit these stresses to relieve themselves somewhat; therefore furnace coolings *in vacuo* show the least expansion. Slowing down the rate of reaction is due to coagulation of graphite particles, as observed under the microscope. White cast iron, not having the duplex structure, does not grow on repeated heatings, the changes at the transformation being reversible. About one-third the total expansion is due to decomposition of cementite, the remainder to minute fissures caused by differential expansion of various microportions.

Gray iron heated in air exhibits the same phenomena as *in vacuo*. The expansions at Ar_1 are more intense at first, but slow down more rapidly. The contraction at Ac_1 is almost absent, thought to be due to the oxidation of iron along the graphite flakes, thus preventing solution at these areas. Large expansions during Ar_1 are also due to filling the cavities with oxide, preventing them from adjusting their volume to the surrounding conditions. Very slow heatings and coolings in air cause greater volume changes at A_1, thus being opposite to the effect in vacuum, a discrepancy explained by the author as due to the more extensive diffusion of carbon and the continuous oxidation of the ferrite ground mass.

Studies on Aluminum Alloys Capable of Improvement by Aging

W. Fraenkel and E. Scheuer (*Z. Metallkunde*, vol. 14, pp. 49 and 111, 1922) have investigated with great care the electrical conductivity of alloys of the Duralumin type, including those containing zinc, in the annealed, as quenched, naturally aged and artificially aged condition. Elasticity, resistance to corrosion, electromotive force in aluminum sulphate solution, thermo-electric force and density were also studied, the purpose being to learn the true explanation of the improvement which takes place during aging.

The change in specific resistivity during the aging is most significant, especially since marked differences were found in the behavior of the naturally aged (at room temperature) and artificially aged (at 100 deg. C.) specimens.

Starting with the annealed metal, they found that heat-treating and quenching increased the resistivity, which indicates that this operation has caused the formation of a solid solution. If the aging consisted in the precipitation of the dissolved components, as believed by Merica and others, it should be accompanied by a decrease

in resistivity. Actually, aging at room temperature was accompanied by an increase in resistivity, indicating that there must be some other phenomenon involved. Aging at 100 deg. C. caused the resistivity to decrease about as much as it increased when the aging took place at room temperature. Nevertheless the physical properties obtained by these two methods of aging are practically identical.

The authors conclude that the aging pnenomenon at low temperatures consists in the formation or increase in concentration of a solid solution, as a result of a chemical reaction between the additions (particularly magnesium) and aluminum. Accordingly the aging consists of two simultaneous changes —the chemical reaction and the formation of the solid solution.

It is conceivable that one of these phenomena might take place without the other. This case seems to occur when the aging takes place at elevated temperatures, since we have here the increased strength, but a decreased resistance. The increased strength is supposed to be due to the formation of the chemical compound.

Instead of considering the aged state of the alloy as a metastable one lying between the "as quenched" state and the stable annealed state, as previous workers have done, the authors consider it more probable that it is the state which is really stable at ordinary temperatures. After annealing and slow cooling, the constituents are so much separated that the stable compound cannot form at a measurable rate, on account of the extremely slow rate of diffusion. The reaction can take place only when the separation is prevented by the rapid cooling of the solid solution obtained at the heat-treatment temperature.

This theory, based on the measurements of electrical conductivity, is found to be in harmony with the experiments on the other properties, so far as they can be interpreted.

Book Reviews

PRACTICAL TANNING. By *Allen Rogers, Ph.D.* 699 pages, 124 illustrations. New York: Henry Carey Baird & Co., Inc., 1922. Price $10.

While based in part on the third edition of Flemming's "Practical Tanning," the present volume bears little resemblance to the earlier ones, which were simply collections of miscellaneous recipes and formulas. Dr. Rogers has grouped related topics under suitable headings and presented these in logical sequence so that the whole forms a connected story of the leather industry. Material from the earlier edition has been supplemented by data from Dr. Rogers' experience and from many other sources. While it is obviously impossible to present a manufacturing manual for such an extensive and varied industry within the space of a single volume, the tanner will find a great number of suggestions relating to practical details of tannery operations.

The policy followed intentionally throughout the book of emphasizing the practical side to the almost complete exclusion of theoretical considerations would seem to imply that success in the tannery depends more upon having a good formula than upon an understanding of the nature of the reactions involved. This is not in accordance with the experience of many other industries and advance in the leather industry will be slow as long as empirical methods predominate.

While, as indicated above, the book has been prepared primarily for the practical tanner, it will be of interest to students and others desiring information regarding modern practice in leather manufacture. A variety of modern illustrations serve to increase the attractiveness of the volume.

ALAN G. WIKOFF.

DUST EXPLOSIONS. By *David J. Price* and *Harold H. Brown.* Published by National Fire Protection Association, Boston, Mass. 320 pp., 87 illustrations. 1922. Price $3.

This discussion of the theory, nature of and causes of dust explosions is by two authors whose names are already well known in the literature of this subject. In this particular work they are assisted by two other able investigators whose co-operation is acknowledged on the title page—namely, Hylton R. Brown and Harry E. Roethe. The two principal authors and these men associated with them are all members of the technical staff of the Bureau of Chemistry, in which department they are directly responsible for the work on dust-explosion prevention.

As pointed out in the preface of this work, the general subject has not received anything like serious consideration until very recently. However, the tremendous importance of protection of industrial establishments against the hazard of dust explosions is now well recognized.

This work will be of immense value to the construction engineer as well as to those responsible for operating practice. It gives a clean-cut, simple discussion of why a suspension of dust in the air will explode and makes clear not only the possible consequences of such explosions but also the practical means at hand for prevention of the formation of dangerous air-dust mixtures. All the way through the work the reader will be impressed with the very practical nature of the proposals made. It is a great relief to find a safety engineer who writes on such a basis, for all too often the man who specializes in safety devices permits his enthusiasm to run away with his judgment.

The problem of dust prevention is by no means confined to the agricultural and cereal-milling industries, in which lines the disastrous consequences of dust explosions have been most conspicuous. Recent events well illustrate the hazard in fertilizer, metal-powder, rubber, soap, spice, sulphur and many other chemically controlled industries. It will pay every operating management to get a copy of this work and read it carefully. Such reading will be suggestive of many hazards of serious moment which occur throughout the industry. Moreover, the work will suggest readily available means for correcting these conditions at nominal cost. The price of the work will thus be about the cheapest form of explosion insurance which a management can possibly buy.

R. S. MCBRIDE.

METALLURGY OF ZINC AND CADMIUM. By *H. O. Hofman.* 341 pp., 261 illustrations. New York: McGraw-Hill Book Co., 1922. Price $4.

This is the fourth of a series of notable metallurgical treatises by Professor Hofman, of the Massachusetts Institute of Technology. The most pretentious was the "General Metallurgy," issued nearly 10 years ago. The interval is none too much for such comprehensive volumes as Hofman's "Metallurgy of Copper," "Metallurgy of Lead" and the subject of the present review. To round out the series, a "Metallurgy of Minor Metals" and a "Metallurgy of Gold and Silver" are now in preparation.

A reader or student who is acquainted with any of the other volumes will recognize the form and style immediately. I presume that a certain rule was laid down for these treatises: they must be comprehensive and yet be compressed in size. A mere statement of fact is all that is permitted. But it's all there, together with footnotes telling the exact source of information, to which the student can go for further discussion and detail. Unfortunately this gives the impression that the author is merely a compiler—often it appears that a series of index cards were set into type. Such a rule unfortunately submerges the personality of the author, and even masks the fact that he must be acquainted with operating details in order to appraise, as he has done, the relative importance of various publications, and fill the gaps left by periodical literature.

"Metallurgy," as comprised by this volume, is the art of extracting marketable metal from the ore. A number of auxiliary subjects are outlined, such as the ores and chemistry of various chemical compounds. Certain auxiliary operations are also discussed which are not metallurgy, but which have always been done at the zinc smelter (not smeltery), notably the manufacture of retorts—which is pottery—and the manufacture of zinc oxide—which is pigment. A chemical engineer might claim that the important chapter on electrolysis is something else than metallurgy. But even though the book contains preliminary chapters on properties of zinc and its alloys, these matters are discussed merely in order to show what is required of good marketable spelter and the effect of various metallic impurities. The physical metal-

lurgy, metallography, heat-treatment and mechanical working of pure zinc and its remarkably important alloys are not mentioned.

This doubtless is in keeping with the division of the industry in America, where zinc is smelted wherever there is a confluence of ore, fuel and labor, and the metal sent down East to rolling mills and brass works established long before the first pound of virgin metal was won in the States. In fact the book is almost entirely confined to American practice. Thus it supplies a gap in literature; Mr. Ingalls' "Metallurgy of Zinc and Cadmium" is 20 years old, and the quite recent "Zinc Industry," by E. A. Smith, is confined almost exclusively with British conditions.

E. E. THUM.

PUBLICITY METHODS FOR ENGINEERS. 187 pages, illustrated. Chicago: American Association of Engineers, 1922. Price $1.50.

In discussions regarding the lack of real public appreciation of the importance of chemistry and the closely related topic of the diligence with which the average chemist avoids participating in public activities, reference is frequently made to the accomplishments of other professions. While the lawyer is almost invariably set up as the shining example, the engineer has quite often been included in the favored group. Consequently it was with a great deal of interest that the reviewer noted the following paragraph in the book under consideration:

"Take one illustration, as a typical example. 'Creative Chemistry,' a book by Edwin E. Slosson, can teach many lessons about making interesting reading of engineering productions. It originated in a series of articles prepared for the *Independent* in 1917-18, 'for the purpose of interesting the general reader in the recent achievements of industrial chemistry.' The original article and the book itself have been read by thousands of people who were interested in the author's presentation of otherwise dry chemical facts, and without question there has been a tremendous amount of valuable publicity for the chemical profession as a result. The same can be done with engineering subjects."

Chemists who are interested in getting chemistry across to the public—and every chemist should be—will find this book full of valuable suggestions. It is based on papers and discussions presented at the First National Engineering Congress on Public Information, which was held under the auspices of the American Association of Engineers in Chicago, Feb. 25, 1921. The excellent educational material presented at this conference has been edited to eliminate duplication and make easy reading in a handbook. Some idea of the method of treatment can be gained from the chapter headings: Some Reasons for Publicity; The Right Conception of Publicity; Ways and Means That Bring Publicity; Getting News Into the Newspapers; The Publicity Man and What He Needs to Know; Typical Publicity Problems. Approximate estimating cost and an outline of a working plan for public information are included as appendices.

From the chemists' point of view it is also of interest to note that the book closes with an extract from the talk on research information service by Dr. Charles L. Reese which was presented at the Birmingham meeting of the American Chemical Society.

ALAN G. WIKOFF.

CATALYTIC ACTION. By *K. George Falk.* The Chemical Catalog Co., 1922. 72 pages. Price $2.50.

CATALYSIS, WITH SPECIAL REFERENCE TO NEWER THEORIES OF CHEMICAL ACTION. A general discussion held by the Faraday Society. Reprinted from the *Transactions* of the Faraday Society, vol. 17, 1922. 172 pages. Price $2.50.

Dr. Falk has taken the themes which would form the introductory and theoretical chapters of a larger textbook of Catalysis and has expanded them into a 170-page volume. He has profited by the intensified interest displayed in these last years in the mechanism of catalytic processes and has produced a brief volume which should be stimulating and provocative to all chemists, not alone those interested in catalytic processes. For, stripped of the romance which even the chemist sometimes clothes his science—and, in catalysis, hitherto, romanticism has been uppermost—catalysis in its essentials is seen to be a branch of ordinary everyday chemistry and chemical reactions.

Having essayed an earlier, if less successful, volume on chemical reactions, Dr. Falk inquires in the present work how far the theory of intermediate compounds is applicable alike to catalytic phenomena. His answer is given in Chapter III, which demonstrates the applicability of the theory to a number of examples. Many of the catalytic reactions of organic chemistry are the more understandable by reason of such a theory, more especially those occurring in homogeneous systems. The postulation of intermediate compounds in catalysis or the elucidation of the pathway of a simple chemical reaction is, however, no longer soul-satisfying. Energetics, sub-atomic phenomena and the activity of radiation are now all being probed, as Chapter IV and V show, for their contributions to the general theory of reactions.

Chapter VIII, on Contact Catalysis, should have preceded Chapters VI and VII, on Enzyme Actions and the Chemical Interpretations of Life Processes. The point of view now developing with respect to reactions at interfaces involving oriented adsorption (Hardy, Langmuir and others) or the association of catalysts with reactants to form temporary unstable complexes, specific in nature (Armstrong and Hilditch), will go far toward elucidating the more complex life processes. Only the fringes of the problem here have, as yet, been reached. An enormous amount of experimental work is needed upon the basis of theories now outlined. In that work the problem of promoter action, for which Dr. Falk finds no theory as yet, will find its solution. Let us hope that the perusal of the volume will send yet more experimentalists into the field, that the outline here presented may be enlarged and developed.

The reprint of the general discussion on "Catalysis, With Special Reference to Newer Theories of Chemical Action," conducted by the Faraday Society in September, 1921, has an interest for a far wider chemical audience than that particularly engaged in catalytic work. It emphasizes anew the important influence which a numerically small society can exercise in the development of chemical science. It is a challenge to those who are at present busied with the problem of improving the service which the American Chemical Society renders to its members through its stated meetings. For here we have a record of a symposium admirably organized, with papers preprinted for the members desiring to attend so that useful discussion may be possible. The contributors to the symposium were acknowledged experts and from many lands, Perrin of France, Langmuir, Arrhenius, Lewis, Baly and others. The argument was concentrated on well-defined aspects of the particular problem, the radiation theory in the one hand and surface reactions on the other. The mind of the meeting was thereby directed to definite issues and vagueness and diffuse generalities were accordingly absent. The whole was carefully matured long months before the meeting took place, little being left to the hasty activities of last minute enterprise. The genius of the organizing secretary, F. S. Spiers, should be noted and his procedure emulated.

The volume extends the benefit of the discussion to a wider audience. Herein may be found complements to the outline discussion in Dr. Falk's book. The section on the radiation theory represents the most comprehensive statement of the theory yet put forward. Perrin's brilliant exposé of theoretical aspects of the problem is supplemented by Lewis' statements of attempted experimental verification. Baly summarizes the point of view which has led him to his recent work on photocatalytic processes such as the hydrogen-chlorine combination, the mechanism of carbohydrate and protein synthesis. The discussion contributed by Langmuir and Lindemann enables the reader to maintain a just perspective as to the merits and defects of the theory.

In the section devoted to Surface Reactions it was fitting that both contributions should be by Langmuir. Here will be found a general résumé of the subject and a detailed study of platinum catalysis of the oxidation of hydrogen and carbon monoxide. The point of view and the experimental method are both useful as models for much future work.

HUGH S. TAYLOR.

Recent Chemical & Metallurgical Patents

American Patents

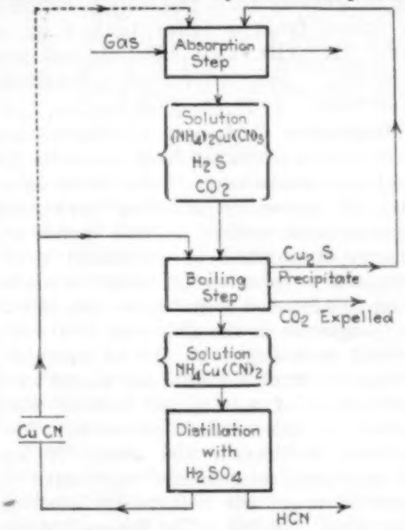
Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Oxidizing Olefines—A number of unusual products may be obtained by the oxidation of the hydrocarbons obtained in the cracking of petroleum distillates. Not long ago Professor James of the Carnegie Institute of Technology outlined a catalytic process for this oxidation which yielded, among other materials, a number of fatty acid products of very interesting properties. More recently Carleton Ellis, of Montclair, N. J., has been granted a patent for the oxidation of such or similar products by the use of nitric acid. As a raw material he uses the acid extract which may be obtained by dissolving the various olefine products in sulphuric acid, cooling and agitating to yield a solution of alkyl-hydrogen-sulphates or similar products. By treating this extract with nitric acid or with an oxygen-containing compound of nitrogen, various ketones and fatty acids are obtained. The process is not limited to the acid extracts, but is also applicable to the alcohols produced by the hydrolysis of such an acid extract. (1,418,368; assigned to Seth B. Hunt. June 6, 1922.)

Purifying Hydrogen — Hugh Scott Taylor and E. K. Rideal have developed a process for obtaining pure hydrogen by means of the well-known iron steam process. As used at present, the process produces hydrogen containing appreciable quantities of carbon monoxide and carbon dioxide, the latter of which impurities is easily removed. It is almost impossible, however, to remove the carbon monoxide by a simple process, and the authors showed in their researches that the proportion of steam increases in relation to the hydrogen present as the gases emerge from the iron retort during any single make period. (The make period is, of course, the period during which steam is allowed to flow through the hot iron.) During this same period the ratio of carbon monoxide to carbon dioxide decreases. Utilizing these two phenomena, the authors have developed what might be called a preferential combustion of the carbon monoxide to carbon dioxide by steaming the impure hydrogen. This changes the CO to CO_2. This process will have distinct advantage in industries where pure hydrogen is highly desirable, such as the hydrogenation of fats and oils. (1,411,760; April 4, 1922.)

Vulcanizing Caoutchouc—Clayton W. Bedford has patented the use of methylenediphenyldiamine as an accelerator in vulcanization. Combining this or another one of Schiff's bases with sulphur in the ratio of 198 to 64 gives a compound which he designates as the sulphur-nitrogen accelerator. This process is patented as well as the application to rubber. The producer also can be produced by using a solvent such as aniline with sulphur and methylene aniline. Still another form is being made by the use of methylene aniline (dipolymer) and sulphur alone. Vulcanization of a mix of 16 parts zinc oxide, 16 parts of rubber, 1 part of sulphur and 1 part of the accelerator takes about half the time required for vulcanization without the accelerator. In addition, a higher tensile strength, a higher modulus of elasticity and other properties are also claimed by the author. (1,418,772; June 6, 1922.)

Extraction of Cyanide From Gases—The object of these inventions is extraction of cyanides or hydrocyanic acid from gases in the form of alkaline cupro-cyanide and recovery as such or conversion to other cyanide compounds.



The scheme of operation for recovery of hydrocyanic acid is shown diagrammatically. The application of these reactions to the recovery of cyanides is obvious. (1,413,762 and -63; Max E. Mueller, of Youngstown, Ohio. April 25, 1922.)

Purification of Gases by Selective Oxidation—This process comprises the catalytic removal of catalyzer poisons from gases which are subsequently subjected to the action of catalysts. In this way the danger of poisoning or destroying the efficiency of catalysts is removed or substantially avoided.

The invention comprises the passing of the gases through a sorbent oxidizing catalyst at a low temperature, the gases being previously mixed with the necessary quantity of air or oxygen when the amount of impurities is large and when the amount is small, being without such admixture.

Among the objects of the invention is the removal of oxidizable gases such as carbon monoxide, from other oxidizable gases, such as hydrogen, in such gases as water gas or other gas mixtures and the removal of such impurities as arsine and phosphine from gases, such as acetylene, ammonia, or the like, to produce respectively pure hydrogen, acetylene, ammonia, etc., and to accomplish such removal at low temperatures. In other words, it might be said that one of the objects of the invention is to provide a process whereby combustible mixtures may be purified by selective oxidation of certain of the constituents.

It may be stated as a general rule that a mixture of metallic oxides consisting of two or more oxides, one being polyvalent and the other mono- or di-valent, will produce the desired oxidation, when properly prepared. The catalysts are active from the start even when operating at low temperatures. In other words, when the gases are brought in contact with the catalysts the oxidation begins at once.

The choice of the material to be used in any particular oxidation depends on the ease with which the oxidation takes place at the desired temperature, and the temperature at which the oxidation will take place will depend upon the quantity of the impurities in the gas and, to some extent, the humidity of the mixture.

The catalysts are prepared in the manner set out in the Patent 1,345,323, dated June 29, 1920, by J. C. W. Frazer and C. C. Scalione. These methods of preparation involve the initial preparation of the material in a very finely divided state, preferably by precipitation, substantially complete removal of the impurities, such as the excess of precipitant, collection of the material, thorough kneading in order to very intimately mix the constituents, formation into a more or less dense cake, and drying of the cake at low temperatures.

Specific examples of the preparation of a copper oxide catalyst and one composed of copper oxide or carbonate and manganese dioxide are given.

Other mixtures such as ferric oxide, manganese dioxide, bismuthic oxide and copper oxide may be used if properly prepared as indicated. (1,418,246; Joseph C. W. Frazer, Baltimore, Md., Arthur B. Lamb, Washington, D. C., and David R. Merrill, Newark, N. J. May 30, 1922.)

Coke-Oven Construction — The triangular flue oven which has been adopted in recent construction for the Koppers Co. installations is described by this patent. Claims for the improvement are increased flexibility in operation and adaptability of the oven for operation with either producer gas or coke-oven gas as the fuel. The invention also contemplates burning these fuel gases either with preheated air alone or with preheated air in an atmosphere containing large quantities of a neutral gaseous diluent which enables control of the combustion, even distribution of the heat over the entire heating wall area, and avoidance of the harmful effects of flame concentration. The structural advantages due to triangular instead of rectangular flues are also emphasized both from the standpoint of construction and operation of the oven. Features of con-

struction of the fuel gas, air and diluent-gas inlet and outlet valves are also covered in the description in some detail. (1,416,322; Joseph Becker, of Pittsburgh, Pa., assignor to the Koppers Co. of Pittsburgh, Pa.)

British Patents

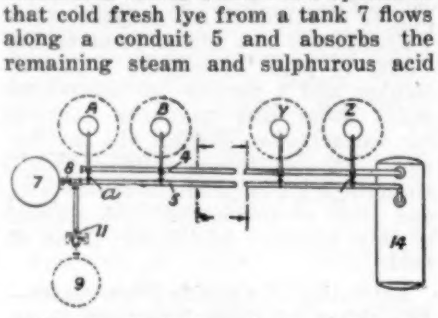
For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Vegetable Oil Extraction—The extraction of vegetable oils and fats by means of relatively low pressure is effected by humidifying the oleaginous matter before pressing so as to produce cellular exudation of the oil. The desired humidity may be obtained by exposing the material to steam or to atomized water until its weight has increased by 10 to 40 per cent. The pressing may be effected while the material is hot or cold, and one-tenth of the pressure employed in the usual process is sufficient. In the case of coconut oil and peanut oil pressures of 5 to 10 kg. per sq.cm. are suitable. (Br. Pat. 179,191; not yet accepted. Cellulose et Papiers Soc. de Richerches et d'Applications, Paris. June 28, 1922.)

Fertilizer From Waste Sulphite—A fertilizer is obtained by causing a reaction of waste sulphite lye from the manufacture of cellulose with matter adapted to bind the water of the lye. Quicklime or a mixture of quicklime and magnesia are suitable for the purpose. Hot concentrated lye is preferably used and peat dust may be added to the mixture. The product is ground for use, and fertilizing agents may be added either before or during grinding. (Br. Pat. 179,151; not yet accepted. Zellstoff-Fabrik Waldhof, Mannheim. June 28, 1922.)

Chromium Electrolysis—Alkali chromates are obtained by electrolysis of alkali carbonate solution with anodes of ferrochromium, and without a diaphragm. The chromate may be converted into bichromate by continued electrolysis after complete conversion of the carbonate. Concentrated solutions are preferably employed, so that the resulting chromate or bichromate solution is near the crystallizing point. To obtain neutral chromate, bichromate may first be formed and excess of alkali carbonate then added. Iron oxide is formed as a precipitate and is removed from time to time by agitation and filtration of the liquid or by centrifugal separation. The anodes may alternately consist of carbon chromite and tar heated below fusion to partially reduce the oxide of chromium. The cathodes may be of lead. Ferrochromium anodes should contain not less than 40 to 45 per cent of chromium. A high current density of some hundreds of amperes per square meter is employed so as to heat the electrolyte. Alternating current may be used. The electrolysis may be carried out in a series of baths between which the electrolyte circulates. (Br. Pat. 177,174; not yet accepted. A. J. B. Jouve and A. Helbronner, Paris. May 10, 1922.)

Sulphite Cellulose—In regenerating the waste heat and sulphurous acid from a system of sulphite cellulose boilers *A*, *B*—*Y*, *Z*, valves leading by conduit 4 to the tank 14 are opened and the pressure thus reduced to about 2 atmospheres. These valves are then closed and valves *a* and 8 are opened so that cold fresh lye from a tank 7 flows along a conduit 5 and absorbs the remaining steam and sulphurous acid



evolved by the boilers *A*, *B*—*Y*, *Z* and is collected in the tank 14, where it is finally saturated to the desired degree with sulphurous acid. The lye may run by gravity from the tank 7, or may be forced from a lower tank 9 by a pump 11. (Br. Pat. 179,150; not yet accepted. Zellstoff-Fabrik Waldhof, Mannheim. June 28, 1922.)

Magnesium Carbonate — Magnesium carbonate is prepared from dolomite by treating a suspension of the burnt dolomite in water or alkaline carbonate solution with carbon dioxide under ordinary, diminished or increased pressure, the proportion of burnt dolomite being so adjusted that "in the treatment the magnesia in the dolomite is always present as a deposit." In an example, 100 kg. of burnt dolomite are mixed with 1,500 liters of water, and treated with carbon dioxide under pressure. The mixture is filtered, and about 70 kg. of hydrated magnesium carbonate is obtained from the filtrate by heating. (Br. Pat. 176,785. T. Simon, Mark, Germany. May 3, 1922.)

Decomposing Leucite—Aluminum and potassium chlorides are separated from solutions of leucite in hydrochloric acid by the following cyclic process. A hot, highly saturated solution of leucite in hydrochloric acid is cooled to atmospheric temperature, when most of the potassium chloride crystallizes and is removed. The molten liquor is then treated with gaseous hydrochloric acid either by spraying the liquor into the gaseous hydrochloric acid or by passing the latter into the mother liquor. The aluminum chloride, which is thereby precipitated, is removed, and the mother liquor is used for treating fresh quantities of leucite. (Br. Pat. 176,770; not yet accepted. G. A. Blank, Rome. May 3, 1922.)

Treating Chromium Ores—Ores containing oxides of chromium are treated for the purification or concentration of the chromium constituent by submitting the ore to the action of a halogen or gaseous halogen acid, for example chlorine or hydrochloric acid, or a mixture thereof, with or without the addition of hydrogen, at such a temperature as to convert some of the constituents of the ore into volatile halogen derivatives. The temperature or the nature of the halogen atmosphere may be adjusted or varied so as to obtain selective distillation of the halogen derivatives; or two or more derivatives may be volatilized and collected together, or separately collected by fractional condensation or by absorption in a solvent for one or more of the constituents. For example, the iron may be volatilized from crushed and washed chromite by treatment at about 900 deg. C. with a mixture of hydrochloric acid and hydrogen, the chromium being afterward volatilized by raising the temperature to 1,200 deg. C. and passing chlorine over the residue; or the iron and chromium may be volatilized together by heating throughout at 1,200 deg. C. (Br. Pat. 176,729. W. H. Dyson, Ringwood, Normandy, and L. Aitchison, Birmingham. May 3, 1922.)

Loading Paper Pulp—The mineral salts, such as barium sulphate, used as filling for paper pulp, are maintained in suspension by the addition of water glass. Magnesium chloride solution or other salts, or acids, which precipitate the silica, may be used. Where mineral carbonates are used, their conversion into salts is preferred. (Br. Pat. 177,-137; not yet accepted. F. Reichard, Berlin, May 10, 1922.)

Sulphur—Finely divided or colloidal sulphur is obtained by evaporation of ammonium polysulphide solution in presence of a protective colloid. Various protective colloids, or waste materials containing them, may be used, as for example saponines, gelatine, casein, sodium lysalbinate, waste sulphite liquor, naphthol pitch and glycerine foots. Evaporation of the solution may be accomplished in any convenient way; also, it may be continued until evolution of ammonia and hydrogen sulphide is complete, or the solution remaining after the removal of part of these gases may be neutralized with acid and then treated with an oxidizing agent, when the sulphur liberated from the hydrogen sulphide is also obtained in the colloidal state. In an example, a concentrated solution of ammonium polysulphide is run slowly into a boiling 0.5 per cent solution of soap. A white milk of sulphur is obtained. This may be removed from the solution, for example by the addition of an electrolyte, and the mass, after separating, may be reconverted into a stable sol by shaking with water. (Br. Pat. 117,103. Badische Anilin und Soda Fabrik, Ludwigshafen-on-Rhine. May 10, 1922.)

Litharge—Litharge is produced by the auto-oxidation of very finely divided lead. The lead is first powdered by putting lead balls into drums slowly revolving at, for example, 25 r.p.m. The oxidation is started by moisture or heat and then proceeds of itself; more lead power is added at a proper rate. The litharge can be converted into red lead according to known practice by heating in a furnace or pan at a temperature below 500 deg. C. (Br. Pat. 176,924. G. Shimadzu, Kyoto, Japan. May 10, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Montreal Program Promises Big Meeting for American Electrochemical Society

Many Attractions of Canadian City and Social Features Will Add to the Attraction of Strong Technical Program

FOLLOWING its customary agreeable practice of tempering a strong technical program with just the right amount of social and entertainment features, the American Electrochemical Society has completed plans for its Montreal meeting, Sept. 21 to 23. The Society headquarters will be at the Windsor Hotel, where registration will begin Wednesday evening, Sept. 20.

The Canadian city offers a number of attractions which aid in making it an ideal location for a convention of this kind. The drives about Montreal, in the Mountain Park, around Mount Royal and along the banks of the St. Lawrence and Ottawa rivers afford delightful views, unsurpassed in America. On Sherbrooke Street is one of the most beautiful buildings on the continent—the art gallery of the Art Association of Montreal. It has a splendid collection of paintings and sculptures. Within a stone's throw is also McGill University, with its magnificent buildings and campus. The Redpath Museum, one of the university buildings, is well worth a visit.

At Ste. Anne de Bellevue, 25 miles from Montreal and reached either by boat or train, is the Macdonald Agricultural College, built and equipped at a cost of over $5,000,000 and presented to McGill University.

The most interesting of all the old French buildings is the Chateau de Ramezay, named after Claude de Ramezay, the eleventh Governor of Montreal, who was born in France in 1657. The Chateau de Ramezay was built in 1705 as a mansion for the famous Baron de Longueuil.

There is one experience which no visitor should miss, and that is to "shoot" the famous Lachine rapids. These rapids are formed by the leaping of the St. Lawrence River over rocky ledges as the river descends swiftly to the level of the Montreal harbor.

Social Features

The Kanawaki and the Royal Montreal (Dixie) Golf clubs will afford golf enthusiasts an opportunity to compete for the Society championship. On Friday evening an old-fashioned smoker will be given by the local committee at the Windsor Hotel.

The visiting ladies will be entertained by sightseeing trips, theater parties and teas at the golf clubs. On Thursday evening the ladies will attend a lecture by Prof. A. S. Eve on "The New Philosophy of Physics" at McGill University.

Local members of the Society of Chemical Industry, Engineering Institute of Canada, Canadian Institute of Mining and Metallurgy, the faculty staff of McGill University and of Montreal University (Ecole Polytechnique) are cordially invited to attend the meetings and entertainments.

Excursions

There will be a special private train to Shawinigan Falls, leaving Windsor Station Friday at 11.30 at night, arriving at Shawinigan Falls at 7.30 a.m. The members will have a rare opportunity to inspect the following industrial plants: Belgian Industrial Co., Canada Carbide Co., Canadian Carborundum Co., Laurentide Power Co., Laurentide Pulp & Paper Co., and the Shawinigan Water & Power Co.

Opportunity will also be afforded for visitors to inspect the numerous industrial establishments in the vicinity of Montreal, including the St. Lawrence Sugar Refinery Co., Canada Cement Co., Imperial Oil Co., Dominion Engineering Works and the C. P. R. Angus shops.

The technical sessions on Thursday and Friday will be held in the Auditorium of the Windsor Hotel. The program follows in full:

Thursday, Sept. 21

10 a.m. Session for Reading and Discussion of Papers.

Norman B. Pilling: Effect of Heat-Treatment on the Hardness and Microstructure of Electrolytically Deposited Iron.

R. P. Neville and J. R. Cain: The Preparation and the Mechanical Properties of Vacuum-Fused Alloys of Electrolytic Iron With Carbon and Manganese.

Ralph B. Abrams: The De-zincification of Brass.

Walter G. Traub: Electroplated Zinc and the Diffusion of Electrodeposits Into Zinc.

John T. Ellsworth: The Effect of Single Impurities on the Deposition of Zinc From Sulphate Solutions.

M. R. Thompson and C. T. Thomas: The Effect of Impurities in Nickel Salts Used for Electrodeposition.

Ernest A. Vuilleumier: The Application of the Contractometer to the Study of Nickel Deposition.

12:45 p.m. Adjournment.

1 p.m. Meeting of board of directors at luncheon, Windsor Hotel.

2 p.m. Session devoted to papers and discussion on "Industrial Heating"; Bradley Stoughton, chairman, Electrothermic Division.

Charles P. Steinmetz: The Underlying Principles of the Industrial Heating Problem.

E. F. Collins: Electric Heat; Its Generation, Propagation and Application to Industrial Processes.

E. J. Smalley: Principles of High-Temperature Furnace Design.

Wirt S. Scott: Advantages of Industrial Electric Heating.

M. A. Hunter and A. Jones: Some Electrical Properties of Alloys at High Temperatures.

C. E. Williams: Resistivities of Some Granular Resistor Carbons.

J. C. Woodson: Heat-Insulating Materials for Electric Heating Apparatus.

Friday, Sept. 22.

9:30 a.m. Session on "Industrial Heating"; Part II.

Frank W. Brooke: Methods of Economically Handling Materials in Electric Furnaces.

Wirt S. Scott: The Development of Industrial Electric Heating for Low-Temperature Enameling.

E. T. Smalley: Treatment of Ceramics.

(Continued on page 519)

English Engineering Societies Form Joint Council

It is announced that proposals for closer co-operation among the leading English engineering institutions, which have recently been under consideration, have now received the approval of the institutions whose representatives met in conference—namely, the Institution of Civil Engineers, Institution of Mechanical Engineers, Institution of Naval Architects and Institution of Electrical Engineers—and that an Engineering Joint Council composed of representatives of these bodies has been formed.

The objects of the Joint Council will be, among others, to improve the status of engineers, to obtain the better utilization of their services in the country's interests and the appointment of properly qualified individuals to responsible engineering positions, and to prevent the unnecessary duplication of activities. At a later stage the number of bodies represented on the Joint Council may be increased.

Government Begins Chemical Foundation Suit

Equity Proceedings to Be Conducted in Delaware—List of Preferred Stockholders Numbers 158 Firms

ANNOUNCEMENT by Attorney-General Daugherty that the government's suit against the Chemical Foundation will be filed within the week was made Aug. 29. The original intention of bringing the suit in the District of Columbia has been abandoned and the equity proceedings will be started in Delaware, the state in which the Foundation was incorporated.

For the present, the American industry centers in the Chemical Foundation, which acts as trustee for American manufacturers whom it licenses. Its opponents charge that it obtained patents worth millions for $250,000. The Foundation asserts that this opposition comes from the former German owners of the patents who themselves wish to profit at the expense of the American industry, whose upbuilding is vital to national defense and whose development is resulting in cheaper prices for dyes and chemicals.

Finances of the Foundation

Capitalized at $500,000, the Chemical Foundation has 4,000 shares of preferred and 1,000 shares of common, par value $100 each. Both issues are restricted to 6 per cent dividends out of earnings which, in their option, the Foundation's trustees may distribute. Surplus must be used for educational work. To date no dividends have been paid. Preferred stock is retirable at the option of the trustees. It has no vote. It represents what thus amounts to a voluntary and practically complimentary advance to assure the early financing of the Foundation's activities, or cash-down ambition of American business to further develop a new industry in the experimental stages of which hundreds of millions have been invested.

Any qualified manufacturer may receive a license from the Chemical Foundation. Payment for the privilege is made in royalties ranging from 5 per cent down. Materials for the government may be manufactured without royalty. In the 3 years of its existence, the Foundation has shown a deficit of over $200,000, accounted for by expenditures of $260,000 in publicity and educational work. In the same period the United States Treasury has received $356,090 in royalties from thirty-five licensees of sixty licensed patents granted by the Federal Trade Commission. The Foundation has entered suit to recover this amount.

The Chemical Foundation holds 5,068 patents, 873 trademarks, 492 copyrights, 55 contracts and 22 applications, for which it paid $271,850.

List of Stockholders

The complete list of preferred stockholders of the Chemical Foundation follow, published now for the first time, follows:

Abbott Laboratories, Chicago, $800; Althouse Chemical Co., Reading, Pa., $400; Aluminum Co. of America, Pittsburgh, $800; American Aniline Products, Inc., New York, $800; American Cellulose & Chemical Manufacturing Co., Ltd., New York, $800; American Chemical Society, New York, $800; American Cotton Oil Co., New York, $800; American Platinum Works, Newark, N. J., $800; American Printing Co., New York, $800; Aniline Dye & Chemical Co., Inc., New York, $800; Arnold Print Works, North Adams, Mass., $800; Armour Fertilizer Works, Chicago, $800; Aspinook Co., Jewett City, Conn., $800; Atlantic Dyestuffs Co., Boston, $400; F. E. Atteaux, Boston, Mass., $800; Ault & Wilborg Co., Cincinnati, $3,100.

H. J. Baker & Bros., New York, $800; Baker & Co., Inc., Newark, N. J., $800; George A. Ball, Muncie, Ind., $800; Joseph Bancroft Sons Co., Wilmington, Del., $800; The Barrett Co., New York, $6,500; The Bayer & Co., Inc., New York, $800; Bethlehem Steel Co., Bethlehem, Pa., $800; C. Bischoff & Co., New York, $800; Borne, Scrymser & Co., New York, $800; H. Bowker Chemical Manufacturing Co., Philadelphia, $800; Bronx Co., New York, $800; Brown & Co., Portland, Me., $800; Butterworth Judson Corp., New York, $6,500.

John Campbell & Co., New York, $3,100; Capudini Chemical Company, Raleigh, N. C., $400; Chemical Dyestuffs & Chemical Co., Newark, N. J., $7,200; Antonin Chapel (Catskill Chemical Co.), Brooklyn, $800; Cheney Brothers, South Manchester, Conn., $800; Citro Chemical Co., Maywood, N. J., $400; B. P. Clapp Ammonia Co., New York, $400; R. H. Comey Co., Brooklyn, $800; Commercial Research Co., New York, $800; Commonwealth Chemical Corp., New York, $400; Consolidated Color & Chemical Co., New York, $6,500; Contact Process Co., Buffalo, $800; Crocker Burbank & Co., Fitchburg, Mass., $800; Samuel A. Crozer & Son, Upland, Pa., $800.

Davison Chemical Co., New York, $800; John C. Dehls, Newark, N. J., $800; Dermatological Research Laboratories, Philadelphia, $800; Detroit Chemical Works, Detroit, Mich., $400; Diamond Alkali Co., Pittsburgh, Pa., $800; Dicks-David Co., Inc., New York, $400; Digestive Fermints Co., Detroit, Mich., $400; John V. N. Dorr, New York, $800; Dow Chemical Co., Midland, Mich., $1,500; E. I. du Pont de Nemours & Co., Wilmington, Del., $84,100; Durex Chemical Co., New York, $400; Winthrop C. Durfee, Boston, $800; Dye Products & Chemical Co., Inc., New York, $400.

Eastern Drug Co., Boston, $800; Electric Boat Co., New York, $800; Electro Bleaching Gas Co., New York, $800; Charles Engelhard, New York, $800; The Essenkay Products Co., Chicago, Ill., $800; Essex Aniline Works, Inc., Boston, $500.

General Bakelite Co., New York, $800; General Ceramics Co., New York, $800; General Chemical Co., New York, $33,500; General Electric Co., Schenectady, N. Y., $800; Genesee Pure Food Co., Le Roy, N. Y., $800; George L. Gilmore, Lexington, Mass., $800; The Grasselli Chemical Co., Cleveland, $20,000.

Harovia Chemical & Manufacturing Co., Newark, N. J., $800; Hardwick & Magee Co., Philadelphia, $800; The Heller & Merz Co., Newark, N. J., $13,200; Hercules Powder Co., Wilmington, Del., $800; Herf & Frerichs Chemical Co., St. Louis, $800; Hess Goldsmith & Co., Inc., New York, $800; Heyden Chemical Works, Garfield, N. J., $800; Hooker Electro Chemical Co., New York, $6,500.

Irvington Smelting & Refining Works, New York, $800; Isco Chemical Co., New York, $800.

Johnson & Johnson, New Brunswick, N. J., $800.

Kelly-Springfield Tire Co., New York, $800; E. C. Klipstein & Sons Co., New York, $800; Walter E. Knipe & Sons, Philadelphia, $800.

La Belle Iron Works, Steubenville, Ohio, $800; Lackawanna Steel Co., Lackawanna, N. Y., $800; Lehn & Fink, Inc., New York, $800; Lewiston Bleachery & Dye Works, Boston, $800; Eli Lilly Co., Indianapolis, $800; Lindsay Light Co., Chicago, $800; Lonsdale Co., Providence, $800; Lowell Bleachery, Lowell, Mass., $800; John Lucas & Co., Inc., Philadelphia, $800.

Mallinckrodt Chemical Works, New York, $800; Marden, Orth & Hastings (Calco Chemical Co.), Bound Brook, N. J., $33,500; Francis T. Maxwell, Rockville, Conn., $800; McKesson & Robbins, New York, $400; Merck & Co., New York, $6,500; William S. Merrill Co., Cincinnati, $400; Merrimac Chemical Co., Boston, $11,900; Metals Disintegrating Co., Inc., New York, $400; H. A. Metz Laboratories, Inc., New York, $6,500; Millville Manufacturing Co., Philadelphia, $800; Monroe Drug Co., Quincy, Ill., $400; Monsanto Chemical Works, St. Louis, $800; George H. Morrill Co., Norwood, Mass., $400; Mt. Hope Finishing Co., North Dighton, Mass., $800; Mutual Chemical Co. of America, New York, $800.

National Ammonia Co., St. Louis, $800; National Aniline & Chemical Co., New York, $25,100; National Electrolytic Co., Niagara Falls, $800; National Silk Dyeing Co., Paterson, N. J., $800; The Naugatuck Chemical Co., Naugatuck, Conn., $800; New Bedford & Agawam Finishing Co., East Wareham, Mass., $400; The Newport Co., Milwaukee, $13,200; Niagara Alkali Co., Niagara Falls, $800; Niagara Electro Chemical Co., Niagara, $400.

Ohio Chemical & Manufacturing Co., Cleveland, $800.

Pacific Mills, Boston, $800; Parke, Davis & Co., Detroit, $800; Joseph E. Patchett, Keyser, W. Va., $800; Peerless Colors Co., Inc., Bound Brook, N. J., $800; Pennsylvania Salt Manufacturing Co., Philadelphia, $800; Permutit Co., New York, $800; Perth Amboy Chemical Works, Perth Amboy, N. J., $400; Charles Pfizer & Co., Inc., New York, $800; Philadelphia Textile Machine Co., Philadelphia, $800; Philadelphia Tapestry Mills, Philadelphia, $800; Powers, Weightman & Rosengarten Co., Philadelphia, $800.

The Rector Chemical Co., New York, $400; Republic Iron & Steel Co., Youngstown, Ohio, $800; Rhodia Chemical Co., New York, $800; The Roessler & Hasslacher Chemical Co., New York, $800.

Sayles Finishing Plants, Saylesville, R. I., $800; Schieffelin & Co., New York, $400; Solvay Process Co., Syracuse, $800; Semet Solvay Co., Syracuse, $6,500; Sherwin-Williams Co., Cleveland, $3,100; Frederick Stearns & Co., Detroit, $400; J. L. Stifel & Sons, Wheeling, W. Va., $800; E. R. Squibb & Sons, New York, $800.

Tartar Chemical Works (Royal Baking Powder Co.), New York, $400; Toch Brothers, New York, $400.

Union Carbide & Carbon Co., New York, $800; Union Bleaching & Finishing Co., Greenville, S. C., $800; United Drug Co., Boston, $800; United Piece Dye Works, Lodia, N. J., $800; United States Color & Chemical Co., Boston, $1,800; United States Finishing Co., New York, $800; United States Industrial Alcohol Co., New York, $800; The Upjohn Co., Kalamazoo, Mich., $800.

The Viscoloid Co., Leominster, Mass., $800.

George J. Wallau, New York, $800; The Wanskuck Co., Providence, $800; West Virginia Pulp & Paper Co., New York, $800; Western Electric Co., Inc., New York, $800; Jacques Wolfe Co., Passaic, N. J., $800.

Youngstown Sheet & Tube Co., Youngstown, Ohio, $800.

Zinsser & Co., Hastings, N. Y., $800.

Preferred Shares Have No Vote

Holders of preferred shares have no vote. The entire voting control is confined to the common stock, which is in trustees' hands.

These trustees are Otto T. Bannard, chairman of the New York Trust Co.; George L. Ingraham, former presiding justice of the Appellate Division of the Supreme Court of New York; Cleveland H. Dodge of New York; B. Howell Griswold, Jr., of Alexander Brown & Co., Baltimore, and Bradley W. Palmer of Boston. The trusteeship extends until 1936, by which time all patents will have expired.

Make Rapid Progress on Tariff

Conferees Postpone Controversial Points Until Last—Changes in Rates Not Announced but Expected in Chemical Schedule

DRIVING at top speed, Republican conferees on the tariff bill have considered and tentatively agreed upon more than half of the amendments to rates which were made by the Senate. Working 7 hours daily and with prospects of night sessions, the conferees have declared that their report will be submitted to Congress by the middle of September.

In making this record of speed, however, the conferees have passed over until the last all highly controversial points in the measure. The question of the basis of valuation to be used in determining ad valorem rates will not be taken up until the rest of the bill has been disposed of. The House used American valuation as its basis—the value of a comparable American article. The Senate used foreign valuation, which has been the basis of all previous tariff measures. In proceeding with discussion of rates, the conferees are using the Senate basis of foreign valuation, but with experts of the Tariff Commission keeping a parallel column translating such duties into terms of the American wholesale selling price of the imported article. This is the so-called Burgess plan, suggested by William Burgess, now a member of the Tarriff Commission, and which was considered and rejected by the Senate Finance Committee when the bill first came from the House more than a year ago. If this plan finally were adopted by the conferees, it would change every ad valorem rate in the bill—and ad valorem rates constitute about 22 per cent of all rates in the bill—and would destroy any accurate basis of comparison with previous tariff laws.

When the House of Representatives debated the rule under which the tariff bill was sent to conference on Aug. 22, an opportunity was given to the leaders on each side of the aisle to express their opinions as to the merits of the measure.

Political Situation

It was predicted freely on the Democratic side that it is the intention of the Republicans to keep the bill in conference until after the election. As long as the bill is in conference, it is contended, a candidate for office can go before the people and promise a favorable outcome in conference on questions where his constituents want to see higher rates and predict the modification in conference of rates which would be hard to defend.

Republican members did not deny that the bill would be held in conference until after the election and it was charged that Democratic campaign members have arranged for price advances on a large number of articles for which increased duties are being provided. If the bill is brought out just prior to the election it was charged that the Democrats have an understanding with importers to advance certain prices arbitrarily with the idea of influencing votes. This would be made possible, it was stated, by the relationship between importers and retailers.

On the other hand, it was contended that the Republicans were afraid to go before the country after having written ridiculously high rates in the law. Emphasis was placed upon assertions that Republicans are divided as never before on the matter of tariff rates. It was stated that many of the great manufacturing interests oppose high rates on the ground that they restrict their foreign market. In addition large loans have been made abroad and it was asserted that American financiers realize that repayment depends to some extent at least on sales made to the United States. One speaker urged the Republicans to bury their tariff bill. "There is already reaction against it," he said. "What we need is not new barriers, new obstacles, new difficulties, but the opening and broadening of the channels of communication between the peoples of the earth."

The Republican answer to that argument was that America's high place in the world as an economic power is the result of the application for over 100 years of the policy of taxing foreign producers for the privilege of selling their products in our markets.

Proceedings Secret

Nothing as to definite agreements on rates is being given out by the Republican conferees. The Democratic conferees are excluded from the sessions and no meetings are being held with reporters, as was done during conference on the tax bill.

Senator McCumber, however, has stated definitely that in the chemical schedule the conferees passed over coal-tar products, rates on which were increased heavily in the Senate by the Bursum amendment, raising the figures and placing them on the basis of American valuation. He also stated that white arsenic, on which the House placed a duty of 25 per cent and the Senate Finance Committee recommended 2 cents per pound but which was placed on the free list by vote of the Senate, had been passed over. It is expected that in the cotton schedule, the additional duty of 4 per cent imposed by the Senate upon yarns and cloths treated with vat dyes will be passed over until the dye rates in the chemical schedule are determined.

While no authoritative information has been given out by the conferees, it is the general understanding in the corridors of both houses of Congress that the conferees have made some reductions in the chemical schedule and in the metals schedule, the latter being in manufactured articles. The cutlery rates were passed over, it is understood.

Expect Fight on Dyes

When the conferees take up the coal-tar rates in the chemical schedule, a vigorous contest is expected. Senator Smoot is opposed to anything like the rates imposed by the Bursum amendment. Somewhat significant of the fight he proposes to wage in the conference was the fact that on the day the bill passed the Senate the Utah Senator obtained adoption of an amendment to the flexible tariff provision of the administrative section which would empower the President to make effective a change in rates of coal-tar products on 15 days' notice, whereas 60 days' notice is required before changes on any other products shall go into effect.

On the other hand, Senator McCumber heartily favors the high rates of the Bursum amendment, and Senator McLean, the third Senate conferee of the Republicans, voted for the high rates and is an ardent protectionist.

Of the House conferees, Representative Fordney, chairman of the Ways and Means Committee, while advocating high rates for dyes and chemicals, has indicated that he believes the Bursum rates "rather high." Mr. Fordney opposed the dye embargo, which was rejected by the House. Representative Longworth favored an embargo and it is believed that he will advocate very high rates of duty on dyes and chemicals. Representative Green of Iowa is rather an unknown quantity in this particular case and it is believed that his attitude largely will determine the issue.

Republican leaders in both House and Senate predict that the new tariff bill will be on the statute books by Oct. 1.

Alpha Chi Sigma Dinner

The dinner of Alpha Chi Sigma, the professional chemical fraternity, which is scheduled for Thursday evening, Sept. 14, at Keen's Chop House, New York City, will be mainly an informal get-together, and the main efforts will be directed toward giving everybody a pleasant evening. No formal talks have been arranged, and it is the arrangement committee's intention to allow the meeting to proceed spontaneously.

The one matter of importance that is to be considered at any length is the fraternity's plan for organizing the alumni members. At present, the strength and enthusiasm of the fraternity is centered in the undergraduate chapters, where there is little real necessity for it. The fraternity has already launched plans to extend the active organization to include graduates and active chemists all over the country, so that Alpha Chi Sigma will more truly rank as a professional fraternity.

Photographic Society Appoints Committees

Steps Taken to Assure Success of Exhibition and Meeting—Chamot Speaks

In connection with the activities of the Technical Photographic and Microscopical Society, which is planning an exhibit and meeting at the Chemical Exposition, a meeting of a number of the active members and officers was called for Aug. 30 at the Chemists' Club in New York. T. J. Keenan, secretary of the society, emphasized the fact that in view of vacancies on the executive committee, there was need of a temporary committee to carry out the details of the program. The following committee was appointed to conduct the affairs of the society in connection with the exposition and annual meeting, when the personnel of the executive committee will be completed: E. R. Morton, chairman, D. S. Mungillo, J. A. Lucas, D. G. Woolf, J. A. Scheick and J. Gibbs. This committee will work in co-operation with the society's exhibition committee, of which A. E. Buchanan is chairman.

A nominating committee was also appointed, consisting of M. W. Cohen, A. E. Buchanan and P. F. Wehmer. Names of the nominees will be presented to the annual meeting of the society at the Grand Central Palace on Sept. 14.

PROF. CHAMOT'S INTERESTING TALK

An interesting talk was delivered by Prof. E. M. Chamot of Cornell University at this meeting, in which the well-known microscopist pointed out some of the things that he hopes the society will accomplish. The speaker mentioned the need for specially designed instruments for industrial microscopical work. The needs of the biologist and bateriologist do not coincide with those of the industrial microscopist, he said, yet the design of standard equipment is entirely dominated by the demands of the former because it is a well-established demand. By the concerted efforts of industrial workers it may be possible to convince instrument makers that there is a field for special apparatus that is worth their attention and thus eliminate the necessity of giving this business to foreign instrument makers.

Dr. Chamot expressed the hope that the society will be able to combat the misguided secrecy that surrounds so many industrial establishments. The war, he said, did much to break down this traditional attitude of mysticism that some firms assume with the idea of keeping their professional secrets from competitors. The technical societies can do a great deal to show proponents of this obsolete idea what a short-sighted policy it really is and how much better work would be done by the employees if a company would encourage their mixing with their coworkers from other organizations and freely interchanging ideas.

Manufacturing Chemists' Association Will Aid DeLong

The executive committee of the Manufacturing Chemists' Association will serve as an advisory committee to the Chemical Commodity Division of the Department of Commerce. This committee will make a survey of the situation and will submit recommendations to Secretary of Commerce Hoover as to how the division can be most useful to the chemical industries. This arrangement was worked out at a conference in which the following participated: Secretary Hoover; Julius Klein, director Bureau of Foreign and Domestic Commerce; C. R. DeLong, chief of the Chemical Commodity Division; Henry Howard, chairman of the executive committee Manufacturing Chemists' Association; S. W. Wilder, Merrimac Chemical Co.; Robert T. Baldwin, National Aniline & Chemical Corporation; Gilbert Currie, Dow Chemical Co.; M. R. Kienle, Mathieson Alkali Co., and John Tierney, Washington representative of the Manufacturing Chemists' Association.

The executive committee of the Manufacturing Chemists' Association will meet Sept. 20 to formulate the recommendations that will be submitted to Secretary Hoover.

Prominent Speakers at Chemical Show

Government Representatives to Discuss Live Subjects During Exposition

Acting Secretary of War J. M. Wainwright has accepted an invitation to address the opening meeting of the National Exposition of Chemical Industries on Monday evening, Sept. 11, at 8 p.m. The title of his address will be "The Relation of the Chemical Industry to National Defense."

Another speaker that will attract many is Wayne B. Wheeler, counsel for the Anti-Saloon League, who speaks on Monday evening, Sept. 11, at 8 o'clock on "The Attitude of the Anti-Saloon League Toward Industrial Alcohol." One of the most vital subjects in the chemical industry today, a discussion of the alcohol question by so eminent an authority as Wheeler will undoubtedly bring out the local chemical, drug, flavoring extract, perfume and allied consuming industries en masse.

On the same evening C. P. Smith, Assistant Commissioner of U. S. Internal Revenue, will fully discuss the subject of industrial alcohol by reviewing the government's regulations upon this commodity.

The Chemical Division of the U. S. Department of Commerce will be represented, with the Bureau of Mines and the Bureau of Chemistry. C. R. DeLong of the Department of Commerce will speak on Sept. 12 at 8 p.m. on "How the Department of Commerce Can Serve the Chemical Industry."

Brigadier-General Amos A. Fries, Chief of the Chemical Warfare Service of the U. S. Army, will attend the exposition and speak on Tuesday evening, Sept. 12, taking for his topic the peace time application of chemical warfare gases in the extermination of forest and farm pests, with comment on other uses of these toxic gases.

Separate auditoriums for the motion picture program and for the speakers at the 1922 Chemical Exposition are to be built on the fourth floor of the Grand Central Palace. Owing to the big program this year, it has been deemed advisable to double the auditorium facilities, separating the motion pictures from the balance of the program.

The standardization program of the 1922 Chemical Exposition, composed of a number of addresses on standardization by well-known authorities, will be held on Friday, Sept. 15, under the direction of the New York Section of the American Chemical Society. Dr. Martin H. Ittner will act as chairman.

Excellent Program for Ceramic Meeting

American Ceramic Society Plans "Ceramic Day" at Chemical Exposition

The American Ceramic Society has provided the program for one of the days during exposition week known as Ceramic Day. This will be on Friday, Sept. 15. President Frank H. Riddle will appear on the opening program of the exposition with the presidents of other technical societies. E. P. Poste and Ross C. Purdy will appear on the special program on "Specifications." Mr. Poste will discuss specifications for enameled chemical ware and Mr. Purdy will describe the problems in writing specifications for refractories.

The partial program follows:

High-Temperature Cements, by W. H. Gaylord, Jr., Quigley Furnace Specialties Co.

Application of Magnetic Separator in Ceramic Industries, by E. S. Hirschberg, Dings Magnetic Separator Co.

Preparation of Clays and Minerals for Ceramic Purposes, by G. D. Dickey, chemist, Industrial Filtration Corporation.

Apparatus for Quickly Determining Fineness of Grind, by Eric Turner, Trenton Flint & Spar Co.

Feldspar Colloquium: W. H. Landers, George M. Darby, O. O. Bowman, 2nd, V. A. Staudt, C. R. Moore, C. M. Franzheim and others.

Manufacture of Gray Enameled Ware, by H. C. Arnold.

Whiting for Ceramic Uses, by A. E. Williams.

Gas Producers for Glass Works, by C. B. Chapman, Chapman Engineering Co.

Witchery of Glazes, by Paul E. Cox.

Architectural Faience and Its Artistic Possibilities, by Conrad Dressler.

Organization of a Decorative Ceramic Research Department; Financial and Manufacturing Considerations, by Frederick H. Rhead.

Electrochemical Society Program

(Continued from page 515)

C. B. Gibson: Electric Annealing of Malleable Iron.

P. S. Gregory: Electric Steam Generators and Their Application.

J. Murray Weed: A New Type of Induction Furnace.

A. Glynne Lobley: A Simple Electric Crucible Furnace for Melting Aluminum.

2 p.m. Reading and Discussion of Papers.

A. E. R. Westman: The Relation Between Current, Voltage and the Length of Carbon Arcs.

George A. Richter: Manufacture of Carbon Bisulphide.

O. C. Ralston: Electrosmosis and Electrophoresis. Two Definitions.

Alexander Lowy and Catherine M. Moore: Electrolytic Oxidation of Isoeugenol.

Alexander Lowy and Henry S. Frank: Electrolytic and Chemical Chlorination of Benzene.

C. W. Vinal and L. M. Ritchie: A New Method for Determining the Rate of Sulphation of Storage Battery Plates.

F. C. Mathers and Jacob W. H. Aldred: Preparation of Perchlorates by Heating Chlorates.

H. C. P. Weber: Changes in the Electrical Conductivity of Varnishes During Drying.

C. J. Rodman: Arc Action on Some Liquid Insulating Compounds.

S. F. Howard and T. A. Martin: The Difference Between the Half Sum and the Square Root of the Product When Weighing by the Method of Gauss.

The excursion train to Shawinigan Falls leaves Montreal at 11:30 p.m. and will return Saturday evening in ample time to permit members wishing to make connections for all through night trains home.

A.I.C.E. to Banquet During Exposition Week

The American Institute of Chemical Engineers will hold its usual banquet during exposition week on Thursday, Sept. 14, at the Hotel Pennsylvania at 6.30 p.m. This dinner has become quite a feature of exposition week and Institute members make plans to visit the exposition so as to be there at that time. Ladies are invited to attend the dinner.

Reservations may be made by writing to the secretary, Dr. J. C. Olsen, the Polytechnic Institute, Brooklyn. They may also be made at the desk of the Chemists' Club and at the *Chem. & Met.* booth (No. 42) at the Chemical Exposition, which will be used as the headquarters of the Institute. Those desiring to attend are urged to make reservation beforehand if possible.

Chemical Exposition Exhibitors Requested to File Catalogs

Under the direction of W. T. Read of the department of chemistry, Yale University, students in the industrial and engineering chemistry course will spend the week of Sept. 11 at the Chemical Exposition in Grand Central Palace, New York. This is the third successive year that Professor Read has brought his students to the exposition. As the supply of catalogs in his department is now out of date, he requests that exhibitors file with the exposition management ten copies of their catalogs and trade literature for the use of his students. The catalogs will not only be used at the exposition but will be filed in the library of the chemical department at Yale University.

Personal

C. C. CONCANNON, a Harvard chemist of the class of 1911, has been appointed assistant chief of the Chemical Division, Bureau of Foreign and Domestic Commerce. Mr. Concannon since 1916 has been connected with Takamine, Inc., and is thoroughly experienced in the details of chemical importing and exporting.

Prof. ROBERT T. HASLAM has been appointed director of the research laboratory of applied chemistry, Massachusetts Institute of Technology, to succeed ROBERT E. WILSON, who has resigned. Professor Haslam has been for some time in charge of the Institute's school of chemical engineering practice.

Dr. SIMON KLOSKY has accepted an appointment as instructor at the Martin Maloney Chemical Laboratory of the Catholic University of America. Dr. Klosky served overseas as First Lieutenant in the Air Service during the World War and is now with the research department of Edgewood Arsenal, Chemical Warfare Service.

WALTER B. LAND has been appointed geologic aid to take the place of H. W. HOOTS in the work on Texas potash. Mr. Lang will be in the chemical laboratory of the U. S. Geological Survey for a short time prior to taking up the work in Texas.

GEORGE WALKER, formerly of the Dorr Co., is now with the Grasselli Chemical Co., Cleveland, Ohio, in the research department.

Dr. GEORGE B. WATERHOUSE, for the past 16 years connected with the Lackawanna Steel Co., Buffalo, N. Y., has accepted the appointment as head of the department of metallurgy at the Massachusetts Institute of Technology, Boston, Mass. He will assume his new duties at the beginning of the college year this fall. Dr. Waterhouse succeeds Prof. H. O. HOFMAN, who resigned last June as head of the department at the Boston institution, after many years of service.

THOMAS H. WICKENDEN and CHARLES MCKNIGHT, JR., have recently joined the development and research department of the International Nickel Co., New York City, to undertake development work in connection with alloy steels. Mr. Wickenden was for many years associated with the Studebaker Corporation as engineer in charge at its South Bend plant, and more recently associated with the Zeder-Skelton-Breer Engineering Co. in a consulting capacity. Mr. McKnight was formerly works manager of the Carbon Steel Co. and engaged for many years in the production of alloy steels.

ROBERT E. WILSON has resigned as director of the research laboratory of applied chemistry, Massachusetts Institute of Technology, to accept a position on the research staff of the Standard Oil Co. of Indiana.

The American Society for Steel Treating has elected the following new officers: President, T. D. Lynch, research engineer, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.; second vice-president, W. S. Bidle, president, W. S. Bidle Co., Cleveland, Ohio; secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio; director, S. M. Havens, assistant treasurer and manager, Ingalls-Shepard Division, Wyman Gordon Co., Harvey, Ill. The board of directors of the American Society for Steel Treating will be composed of the newly elected officiers and the following: First vice-president, R. J. Allen, metallurgist, Rolls-Royce Co. of America, Springfield, Mass.; treasurer, J. V. Emmons, metallurgist, Cleveland Twist Drill Co., Cleveland, Ohio; director, J. J. Crowe, metallurgist, Philadelphia Navy Yard, Philadelphia, Pa.; director, A. E. White, past president, director engineering research, University of Michigan, Ann Arbor, Mich.; director, F. P. Gilligan, past president, secretary-treasurer, Henry Souther Engineering Co., Hartford, Conn. The new officers will begin their duties at the close of the annual convention of the society, which will be held at Detroit Oct. 2 to 7 at the same time as the International Steel Exposition.

Obituary

T. R. L. LOUD, vice-president and general manager of the New York Quinine & Chemical Works, Inc., New York, died Aug. 19, as the result of an automobile accident near Trenton, N. J., while en route to Atlantic City. He was associated with the chemical and drug industries for the past 50 years, and at one time was connected with the Mallinckrodt Chemical Works, St. Louis, and later with the Herf & Frerichs Chemical Co. of the same city. He was 64 years of age at the time of his death.

PAUL F. MCGOVERN, New York manager for the General Alloys Co. and for years the representative of the Quigley Furnace Specialties Co., died almost instantly from an acute heart attack, Aug. 12, 1922.

CHARLES SCOTT, JR., of Philadelphia, vice-president of the Giant Portland Cement Co. and a director of the Railway Steel Spring Co., died at Gloucester, Mass., Aug. 21.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

The Outlook for Better Business

A Survey of Fundamental Economic Conditions Indicates That Once Present Difficulties Are Surmounted, Substantial Business Revival Is Assured

ANY REVIEWER of business conditions must be impressed by the fact that two well-defined, but distinctly opposing, forces are largely responsible for the present situation. His problem in properly evaluating these forces must necessarily involve a consideration of whether their effects are temporary and subject to change either for better or worse or are the result of some fundamental economic movement having a permanent bearing on business progress.

It must be admitted that the labor troubles in the coal fields and on the railroads are of grave significance to industry and at the present moment appear to exert far-reaching effects on industrial activity. Production has been seriously curtailed. Although many industries have suffered and probably will continue to suffer, business refuses to regard the strikes as a permanent blight on the progress toward general prosperity. The ground gained during the past year will not be given up easily. Confidence in the soundness of the underlying situation has not been materially disturbed and there is a widespread conviction that once the difficulties of transportation and fuel supplies are definitely settled, there will be no further obstacles to substantial business revival.

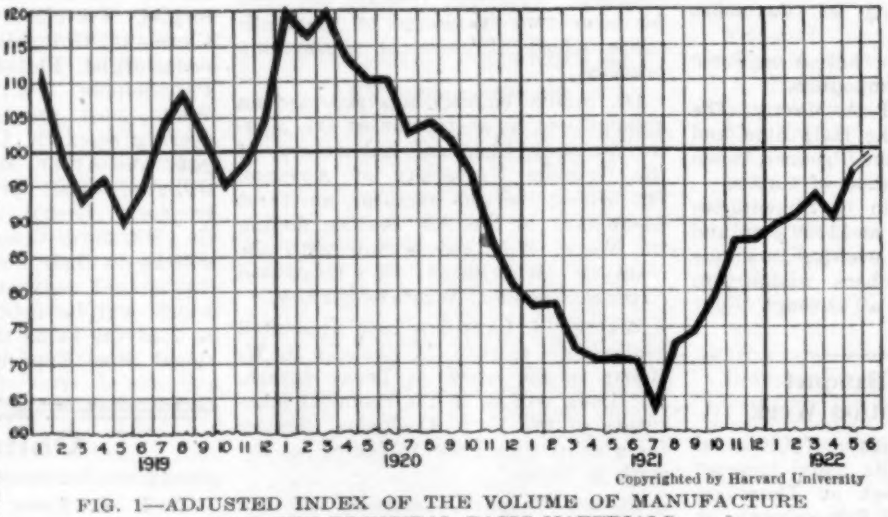


FIG. 1—ADJUSTED INDEX OF THE VOLUME OF MANUFACTURE FOR THE PRINCIPAL BASIC MATERIALS

(*Normal = 100*)

Higher Security Values

This very evidently is the sober judgment of the investing public. Security values have continued at high levels. New records have been set by representative stocks and bonds. The *Wall Street Journal's* average for twenty industrials was 100.75 on Aug. 30, as compared with 92.3 for July 1 and 78.59 for Jan. 10, 1922. The average for the twenty rails has risen from 73.48 for Jan. 3, 1922, to 92.68 for Aug. 30. The Dow-Jones monthly bond index for July reached 75.44, the highest point for several years.

Other fundamental business factors to show improvement in recent months include the decreasing volume of unemployment, the better adjustment of commodity prices, increasing outlook for farm products, increasing car loadings in spite of the shopmen's strike and finally the promise of an early settlement—whether to everybody's satisfaction or not—of the uncertainties of the new tariff bill.

Less Unemployment and Higher Wages

Encouraging news of employment comes from all sections of the country. Reports from sixty-five cities showed that on July 31 1,428 concerns were employing 1,729,085 workers—a gain of 7,434 over the payrolls of June 30. Of these industrial centers, forty-four (mostly in New England and along the Atlantic seaboard) reported increases and twenty-one reported decreases. The Department of Labor's monthly survey of labor conditions by industries shows that in twelve manufacturing industries there were seven increases in employment and five decreases during the month of July. The largest increase, 44.8 per cent, was in the iron and steel industries, while cotton manufacturing showed the largest decrease, 26.4 per cent. Furthermore there have been many significant wage advances, particularly the 20 per cent increase announced by the Steel Corporation and followed by other steel companies. The New York Federal Reserve Bank's index of wages for July was 66 per cent above the 1914 level. Wage increases at this time would seem to confirm the belief that the recent industrial progress has been of a substantial character.

Car loadings of revenue freight had fallen from a weekly average of 351,700 cars in June to 828,029 for July, but the first 3 weeks of August showed a striking recovery to 853,383 cars. In the week ended Aug. 19, 856,219 cars were loaded—an increase of 3,639 cars over the preceding week and of 41,072 over the corresponding week in 1921. The decreases noted in earlier months were due almost entirely to the lower coal loadings.

Progress in the Basic Industries

The Harvard Economic Service's index of the volume of manufacture is based on a combination of three minor indices: (1) Basic materials, (2) pig iron for equipment, vehicles, etc., and (3) consumption goods. The index of basic materials, whose trend since 1919 is shown in Fig. 1, includes iron and steel, lumber, cotton and woolen fabrics, leather and paper. This index stood in June at 99.0, the highest figure recorded since September, 1920. Except for a slight recession in April, this index has shown a consistent upward movement ever since July, 1921. Seasonal influences

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	**150.60**
Last week	149.80
September, 1921	147
September, 1920	267
April, 1918 (high)	286
April, 1921 (low)	140

Three of the twenty-five commodities included in this index were advanced during the past week and there were no reductions. Ammonium sulphate, bleaching powder and linseed oil were reported at slightly higher levels.

have been such, however, that July, 1922, will probably again show a slight recession.

The output of pig iron recorded a slight increase in July—from 2,361,000 long tons in June to 2,400,000 tons in July. Steel ingot production, however, fell from 3,012,000 tons to 2,843,000 tons during this same period. Unfilled orders on the books of the U. S. Steel Corporation showed a gain of 140,630 tons over the previous month.

Pulp and paper production continues at a better-than-average rate. The total output of all grades of newsprint during July, 1922, was 120,839 net tons, while only 94,247 tons was produced in July, 1921, and the 5-year average for the month is 110,000 tons. Wood-pulp production in July, 1922, was 279,308 net tons, a gain of 101,000 tons over July, 1921, and well above the average of 270,850 tons for July, 1919-1922.

Higher prices and a record volume of sales for both foreign and domestic consumption have stimulated the leather industry. Shoe manufacturers are laying in large stocks in anticipation of an unusually good fall trade. Production, especially of sole leather, increased considerably in both June and July. August figures are not yet available, but it is believed that the increased rate has been well maintained.

The American Petroleum Institute estimated the daily average production of crude oil at 1,504,150 bbl. for the week ended Aug. 13. This is a gain of 5,050 bbl. over the average for the preceding week, the largest for any month of 1922.

Heavy Chemical Situation

Manufacturers of heavy chemicals in Philadelphia and vicinity have reported to the Federal Reserve Bank of that district that they can accept no more orders on account of the impending shortage of fuel. At the present time these industries are running at about 80 per cent of capacity, but in most plants the stocks of coal are slight and there is every prospect for seriously curtailing production within the near future.

In the 12 months ended June 30, 1922, exports of all chemicals fell off about 50 per cent, but the foreign shipments of heavy chemicals recorded gains in both volume and value. Exports of acetate of lime and of glycerine doubled, while caustic soda, borax and sodium silicate showed heavy gains. Bleaching powder and soda ash declined.

In general credit conditions are reported as only fair. In proportion to the volume of sales, the accounts outstanding for July have increased from 130.4 per cent in June to 137.5 per cent for July.

Atlas Dividend

A special dividend of 3 per cent on the common stock of the Atlas Powder Co. has been declared, payable Sept. 11, 1922, to stockholders of record at the close of business on Aug. 31, 1922. The stock transfer books will not be closed for the payment of this dividend.

Credit Conditions in the Fertilizer Market

Accompanying the annual report of the American Agricultural Chemical Co. is a statement by the chairman of its board, Robert S. Bradley, which gives a very encouraging view on the fertilizer outlook. Although the demand has not yet returned to normal, there is every prospect for such a return within the near future. Mr. Bradley's statement in part is as follows:

> The sales of fertilizers in the United States for the past year are estimated to have been about 65 per cent of the tonnage of 1920; but while the demand has thus decreased, owing to the severe depression in all agricultural districts during the past 2 years, the productive capacity of the fertilizer industry had been considerably increased under the stimulus of the heavy demand in the spring of 1920. These conditions have naturally led to very severe competition and to a continuance of low prices.
>
> Although there still remains uncollected in the South a large amount of fertilizer notes and accounts from sales of 1920 and 1921, it is estimated, nevertheless, that one-half of all the fertilizer used in the cotton belt in the spring of 1922 was sold for cash, instead of on the usual fall credit terms, and it is confidently expected that the balance of these sales will be collected this fall at maturity, together with a large part of the receivables carried over from 1920 and 1921. Much more fertilizer could have been sold in the South last spring had it not been for the unsatisfactory credit conditions prevailing in that section. From June, 1921, to June, 1922, the price of cotton advanced from around 11 cents per pound to over 22 cents, which latter price should yield a very satisfactory profit on the present cost of production. If the price of cotton should remain around present figures there should be a considerable increase in the demand for fertilizers in the Southern States in the spring of 1923.
>
> In the Northern States credit conditions have been more favorable and a relatively larger tonnage of fertilizer has been sold, though far less than in 1920. Competition in these states has been very keen and prices have remained at a low level.

The annual statement of the American Agricultural Chemical Co. and its associated companies shows a net operating deficit for the year ended June 30, 1922, of $1,124,070.56.

Du Pont Earnings in 1922

For the 6 months ended June 30, 1922, E. I. du Pont de Nemours & Co. reports net earnings of $5,346,857 after deducting all expenses, taxes, depreciation, etc. When provision had been made for $1,403,653 of bond interest and discount, and $2,137,791 for debenture stock dividends, there remained $1,805,412 available for the common stock. This was equivalent to $2.85 a share for the six-month period.

Mathieson Alkali Turn Loss Into Profit

The Mathieson Alkali Works, Inc., operated during the second quarter of 1922 at a net profit of $233,898 as compared with a loss of $361,252 for the corresponding period of last year. The gross earnings were $369,489, from which $135,591 was set aside for depreciation reserves. Payment of preferred stock dividends has been resumed, and it is estimated that after allowances have been made for federal taxes, preferred dividends, sinking fund, etc., the earnings on the common stock will be at the rate of 9.7 per cent per annum.

The New York Market

New York, Sept. 3, 1922.

Activity in the chemical market during the past week has been along broader lines than at any other time for a considerable period. Consumers are showing lively interest in many of the basic commodities. Spot stocks have dwindled considerably and an eager desire to cover has been stimulated by the fear of delayed shipments resulting from the rail and coal strikes. Reports from abroad show that quotations on leading chemicals are much higher than at any time this year. The coal strike in many instances has restricted adequate production and has given the resale merchant an opportunity to get rid of any surplus stocks. Prices on many important items have already advanced and consumers are somewhat uneasy about the chances of obtaining additional supplies. Many are of the opinion that the market shows every sign of broadening materially on an upward basis.

One of the items that commanded the most interest was bleaching powder. Supplies have been taken so quickly that leading producers are unable at present to quote anything but October-November shipments. The alkali situation still remains in an extremely firm position both for home and export consumption. White powdered arsenic has again been advanced by importers and has given rise to keen speculation among resale merchants. Nitrite of soda, prussiate of soda, permanganate of potash, prussiate of potash and oxalic acid have shown considerable activity during the interval.

General and Special Chemicals

Acetate of Soda—Spot supplies are exceedingly low, with production limited to contract specifications. The recent strength in acetate of lime, as well as the higher labor costs, is directly the cause for the advance. Quotations ranged around 7¼c. per lb. for small quantities.

Alums—A moderate consuming business is reported for the lump ammonia alum at 3¼@3½c. per lb. Imported potash alum has been offered down to 3c. per lb.

Aluminum Sulphate—Domestic producers are experiencing a steady call for the commercial grade at 1⅛c. per lb. Sales of iron-free are reported at 2¼c. per lb. The general tone is steady.

Amyl Acetate—Prices are recorded at higher levels and the market presents a steady position. Offerings are rather light, while consumers have shown a better interest for additional supplies. Prices range from $2.25 per gal. upward, depending upon the seller and quantity.

Arsenic—The market remains exceedingly firm, with quantity lots very difficult to obtain either on spot or for prompt shipment. During the later trading prices were advanced to 8½@9c. per pound.

Bleaching Powder—This item has been the feature of the week's trading. Supplies on spot and nearby shipments

have practically been exhausted. Leading factors quote odd lots at $1.90 per 100 lb. ex-store and $2 per 100 lb. for Oct.-Nov. shipment, f.o.b. works.

Fusel Oil—Crude material is moving on the basis of $1.55 per gal., which is somewhat higher than recently quoted. The refined material is also higher, with sellers asking $2.75 per gal. Business is running along regular lines and leading producers seem satisfied with the volume of passing business.

Nitrite of Soda—Large importers and traders have announced an advance on all available spot goods and material for shipment. Higher prices abroad and the scarcity of material for immediate consumption are responsible for the keen interest and renewed speculation. A few odd lots on spot were offered up to 8½c. per lb.

Oxalic Acid—Prices continue to follow an upward course. Buying interest has not ceased and the general tone is very satisfactory. Prices range from 16¾@18½c. per lb., depending upon the seller and quantity.

Prussiate of Potash—Yellow material has been materially advanced during the interval and prices were quoted very firm at 35c. per lb. for small lots. The red variety was quoted higher at 95c.@$1 per pound.

Prussiate of Soda—Activity has increased notably and the tendency of prices has been distinctly higher. Sales were reported for moderate quantities up to 23c. per lb., an advance of 3c. per lb., since our last report.

Coal-Tar Products

Crude coal-tar products have shown considerable strength. It is apparent that the coal and rail situation is directly responsible for the restricted production in some of the these basic commodities, and leading factors are of the opinion that this will eventually force up values of intermediates. The present condition of the market has permitted resale merchants to rid themselves of any surplus stocks. The shortage in phenol is very acute and prices are rising to extremely high levels. Salicylic acids have been affected by this and prices have been advanced.

Benzene—The restricted offerings have placed the spot market in a very strong position. Factors are having trouble in making shipments on old contracts. Future orders are the only transactions being considered. Quotations at the works are firm at 27@32c. per gal. for the 90 per cent and 30 @35c. per gal. for water white.

Cresylic Acid—The market is in a very firm state. The continued inquiries and scant offerings are keeping the market at its present high levels. Domestic offerings for shipment are quoted around 51@53c. per gal. for the 95 per cent and 56@58c. per gal. for the 97@99 per cent. Imported material is quoted at 64@65c. per gallon.

Phenol—There has been a pronounced scarcity of spot material and prices have been sharply advanced. Quotations for odd lots are heard around 23c. per pound.

The Chicago Market

Chicago, Ill., Aug. 29, 1922.

The tone of the industrial chemical market has been firmer during the past 2 weeks. A good volume of business was reported from nearly all quarters, particularly from first hands, for there appears to be a growing tendency on the part of the buyer to purchase his supplies from the manufacturer. There were but few price advances to be noted, although nearly all items were in a very firm position. Imported chemicals in particular were exceptionally firm, as holders had little or no idea of their replacement costs. It was to be noticed that most buyers were willing to pay a small premium for domestic goods.

General Chemicals

Caustic soda was very firm, with only moderate supplies available. Solid 76 per cent material was available in small or moderate lots at $3.85@$4 per 100 lb. and the ground or flake at $4.40 @$4.50. *Caustic potash* was unchanged as to price and was reported to be moving fairly well at 6½@7c. per lb. for the 88-92 per cent material. *Soda ash* continued to move in a good volume and was unchanged at $2.35 per 100 lb. for small lots of 58 per cent material in cooperage. *Sal soda* enjoyed a good inquiry and was available at $1.90 per 100 pounds.

The list of alums was rather quiet, with moderate supplies available. Lump *potash alum*, iron free, was offered at 4½@5c. per lb. in single-bbl. lots and the powdered at 6@6½c. *Sal ammoniac* was quite firm, with first hands in control of the situation. White granular material of domestic manufacture was quoted at 7¾c. per lb. in moderate quantities. *White arsenic* maintained its firm position and was offered at 8½@9c. per lb. *Barium carbonate* was in a firm position and small lots for spot delivery were held at 5c. per lb. The situation on *copper sulphate* was less acute and moderate lots were available at 6½c. per lb. *Carbon bisulphide* was quite firm, with only small quantities available at 7@7½c. per lb. *Carbon tetrachloride* was in about the same position as before and was quoted at 9½@10c. per lb. in large drums. *Glycerine* was in a very firm position with most of the refiners asking 17c. per lb. for the c.p. material in drums. *Formaldehyde* was unchanged both as to price and demand. Supplies were available at 9c. per lb. in single-bbl. lots. *Furfural* was unchanged at 35c. per lb. for 1,000-lb. lots. *Lead acetate* was in no better demand and barrels were offered at 11@12c. per lb. for the white crystals. *Red phosphorus* was very quiet, with imported material offered at 26c. per lb. and domestic at 48c. *Phosphorus pentoxide* was in better demand and was quoted by the one holder at 35c. per pound.

A better demand was to be noticed for bichromates, the coal situation forcing the price upward. *Potassium bichromate* was quoted at 11½@12c. per lb. and soda at 9@9½c. *Potassium chlorate* was very firm and scarce on spot, small lots of the crystals bringing 10c. per lb. *Potassium permanganate* was reported to be in a firm position with supplies getting scarce. Spot U.S.P. crystals were held at 16½c. per lb. and the movement was said to be very fair. *Hyposulphite* of soda was unchanged in price and moved in a routine way at $3.85 per 100 lb. for pea crystals in barrels.

Linseed Oil and Turpentine

Linseed oil was reported to be moving in a fair volume but the price was weak at 92c. per gal. for 5-drum lots of the boiled and 90c. for similar quantities of the raw.

Turpentine was also moving in a fair way, but factors differed on the condition of the market with some predicting a sharp decline, others an advance. Five-drum lots were quoted at the close of today's market at $1.23¾ per gallon.

The Iron and Steel Market

Pittsburgh, Sept. 1, 1922.

A fundamental change has occurred in the past fortnight in the spirit that underlies the iron and steel market. Previously there had been a gradual but very moderate departure from the policy well outlined last June, of holding prices down so as to avoid discouraging buyers for deliveries in the late months of the year, as it grew clearer that on account of curtailed production there would be little to sell. The new thought is that the astonishing and complete success of the coal miners in their strike, with various other developments, makes inflation unavoidable and that in the circumstances no general benefit can accrue from efforts to hold prices down. Banking interests appear to have been the first to sense the situation and to have passed the word around that since labor forces inflation the best course is to let inflation have its way, producing its natural economic consequences, resulting eventually in people in general becoming less extravagant and more willing to work.

The result is that the influences that are usually exerted to prevent a runaway market are not operative. Prices are not going to be pushed up by design, but they are going to be permitted to go up if so disposed—as they are.

Predictions are already being made that "the inflation can't last long," April 1 being sometimes mentioned as an extreme date. The assigned period may easily prove too short. Business has momentum. Not all material still to be received by buyers is at high prices, for in practically all lines of commerce there are forward commitments. Costs of production do not instantly mount when the current market advances. Furthermore, it is being remarked that some bankers have said that "there is too much money" for prices and wages to be held to reasonable levels, in keeping with economic laws, but if that is the case the large amount of money cannot be spent in a short space of time.

The iron and steel industry appears to have assumed that since it has had

nearly 2 years of very lean times and in the past few months production costs quite out of keeping with prices at which the steel made had been sold, it should now make the most of the present opportunity.

Steel Prices Advancing

As reported under date of Aug. 18, the Steel Corporation advanced its sheet prices $2 a ton on blue annealed and $4 a ton on other descriptions, following advances previously made by independents. On Aug. 23 the corporation advanced prices on welded tubular goods three points on black and two points on galvanized, a point being equivalent to about $2 a net ton, 8 days after independents had made a similar advance, and 1 day after the corporation's wage advance had been announced.

The absolute minimum on bars, shapes and plates has advanced from 1.80c. to 1.90c. in the case of bars and to 2c. in the case of shapes and plates, this being for altogether indefinite delivery. The ordinary market is 2.25c., while prompt plates have been bringing 2.50c. for 2 or 3 weeks' delivery. While the Steel Corporation has made no formal announcement as to prices of wire products, it is selling at prices as recently advanced by independents, the advance being $2 a ton on plain wire to 2.35c. and 20c. on a keg of nails to $2.60.

The Steel Corporation on Aug. 22 announced that, effective Sept. 1, it would advance wages generally by 20 per cent. This would raise the common labor rate from 30 to 36 cents an hour. Some of the independents followed instantly, others later. Wages in the Connellsville region were dealt with separately, as will be indicated later. The general wage advance increases the cost of making the average net ton of finished steel by something like $4, the Connellsville wage advance adding something like a dollar more.

On Aug. 22, after the "Cleveland agreement" in the union bituminous coal industry, the H. C. Frick Coke Co. posted notices in the Connellsville region restoring the wage scale of Sept. 1, 1920, the highest scale ever paid in the region, an exception being the rate for outside day labor, which was made to conform to the labor rate at mills and furnaces. The advance was to be effective Aug. 23 and strikers were invited to return to work. Independent operators followed the Frick scale. While some men have returned, the expected stampede has not occurred. This week the Pittsburgh district operators signed the scale and it is a question whether this will affect the Connellsville labor situation favorably or otherwise. The Connellsville region has been non-union for at least 30 years and while the coal strike has presented many surprises, it is inconceivable that the Connellsville operators will sign any agreement.

Connellsville coal and coke prices have been declining, steam coal having reached a range of $4.50@$5, while furnace coke is $10@$11 and foundry coke $13@$14. Blast furnaces are beginning to take hold in a very limited way, the supply offered being very scant and the price still distinctly objectionable. One of the Shenango furnaces resumes this week, on purchases of odd lots of coke, but this is to make bessemer iron, supplied molten on a long term contract to an ingot mold foundry. There is practically no merchant pig iron production in western Pennsylvania and the valleys. The last foundry iron appears to have been sold some time ago, and recourse has been had to Buffalo, where a purchase has just been made of several hundred tons of prompt iron at $34 Buffalo for Pittsburgh delivery, the valley equivalent, considering freights, being $35.50. Bessemer is up to $32 valley on small-lot sales. Basic cannot be had at under $30 valley, and probably not at that figure. The only pig-iron market is a spot or prompt market, forward deliveries being out of the reckoning. When it becomes possible to offer forward deliveries, the expected readjustment in prices may not occur, the resumption being so gradual as to make forward prices in line with the spot market then existing.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Acetic anhydride	lb.	...... –	$0.38 – $0.40
Acetone	lb.	$0.13½ – $0.13¾	.14 – .14½
Acid, acetic, 28 per cent	100 lbs.	2.70 – 2.80	2.85 – 3.30
Acetic, 56 per cent	100 lbs.	5.25 – 5.35	5.40 – 5.75
Acetic, glacial, 99½ per cent, carboys	100 lbs.	12.00 – 12.50	12.75 – 13.50
Boric, crystals	lb.	.11 – .11½	.11¾ – .12
Boric, powder	lb.	.11 – .11½	.11¾ – .12½
Citric	lb.	...... –	.45 – .45½
Hydrochloric	100 lb.	1.10 – 1.20	1.25 – 1.70
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11 – .12
Lactic, 44 per cent tech	lb.	.09½ – .10	.10½ – .12
Lactic, 22 per cent tech	lb.	.04 – .04½	.04½ – .05
Molybdic, c.p.	lb.	3.00 – 3.25	3.30 – 3.75
Muriatic, 20 deg. (see hydrochloric)	....	..... –	..... – .....
Nitric, 40 deg	lb.	.06 – .06½	.06¾ – .07
Nitric, 42 deg	lb.	.06½ – .06¾	.07 – .07½
Oxalic, crystals	lb.	.16¾ – .17	.17½ – .18½
Phosphoric, 50 per cent solution	lb.	.08 – .08½	.08¾ – .09½
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	..... –	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	10.00 – 10.50	..... – .....
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	..... – .....
Sulphuric, 66 deg., tank cars	ton	15.00 – 16.00	..... – .....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	..... –	.29½ – .30
Tartaric acid, imported, powdered	lb.	..... –	.30 – .31
Tartaric acid, domestic	lb.	..... –	..... – .30
Tungstic, per lb. of WO	lb.	..... –	1.00 – 1.10
Alcohol, ethyl (Cologne spirit)	gal.	..... –	4.75 – 4.95
Alcohol, methyl (see methanol)	..	..... –	..... – .....
Alcohol, denatured, 188 proof No. 1	gal.	..... –	.31 – .33
Alcohol, denatured, 188 proof No. 5	gal.	..... –	.31 – .33
Alum, ammonia, lump	lb.	.03¼ – .03½	.03¾ – .04
Alum, potash, lump	lb.	.03 – .03¼	.03½ – .04
Alum, chrome lump	lb.	.05 – .05¼	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02¾	.03 – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06¾ – .07¼	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.08¼ – .08½	.08¾ – .09
Ammonium nitrate	lb.	.06 – .06½	.06¾ – .07½
Amyl acetate tech	gal.	..... –	2.25 – 2.35
Arsenic, white, powdered	lb.	.08½ – .09	.09¼ – .09½
Arsenic, red, powdered	lb.	.12 – .12½	.12½ – .13
Barium carbonate	ton	61.00 – 62.00	63.00 – 66.00
Barium chloride	ton	85.00 – 88.00	89.00 – 95.00
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate	lb.	.07½ – .07¾	.08 – .08½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04¼	.04½ – .04¾
Blanc fixe, dry	lb.	.04 – .04½	..... – .....
Blanc fixe, pulp	ton	45.00 – 55.00	..... – .....
Bleaching powder	100 lb.	2.00 – 2.10	2.15 – 3.25
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax	lb.	.05¼ – .05¾	.06 – .06¾
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lbs.	2.35 – 2.40	2.45 – 2.50
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01¾	.02 – .02½
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.82 – .84
Carbon bisulphide	lb.	.06 – .06½	.06¾ – .07½
Carbon tetrachloride, drums	lb.	.09½ – .10	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chalk, precip.—domestic, light	lb.	.04¼ – .04½	..... – .....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03¾	..... – .....
Chalk, precip.—imported, light	lb.	.04½ – .05	..... – .....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05 – .05½	.05¾ – .06
Chloroform	lb.	..... –	.25 – .32
Cobalt oxide	lb.	..... –	2.00 – 2.10
Copperas	ton	20.00 – 22.00	23.00 – 30.00
Copper carbonate, green precipitate	lb.	.19 – .20	.20½ – .21
Copper cyanide	lb.	..... –	.58 – .60
Copper sulphate, crystals	100 lb.	6.25 – 6.50	6.60 – 6.75
Cream of tartar	lb.	..... –	.23 – .25
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl acetate com. 85%	gal.	..... –	.65 – .70
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	..... –	.90 – .95
Formaldehyde, 40 per cent	lb.	.08 – .08½	.08½ – .09
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	..... – .....
Fullers earth–imported powdered–net	ton	30.00 – 32.00	..... – .....
Fusel oil, ref	gal.	..... –	2.75 – 2.90
Fusel oil, crude	gal.	..... –	1.55 – 1.75
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, c. p. drums extra	lb.	..... –	.17 – .17½
Iodine, resublimed	lb.	..... –	4.20 – 4.25
Iron oxide, red	lb.	..... –	.12 – .18
Lead acetate, white crystals	lb.	..... –	.10½ – .11½
Lead arsenate, powd	lb.	.13 – .13½	.13¾ – .14½
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07¾ – .08	.08½ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06¾ – .07¾
Magnesium sulphate, U. S. P.	100 lb.	2.00 – 2.25	2.30 – 2.50
Magnesium sulphate, technical	100 lb.	..... –	1.00 – 1.80
Methanol, 95%	gal.	..... –	.57 – .58
Methanol, 97%	gal.	..... –	.59 – .60
Nickel salt, double	lb.	..... –	.11 – .11½

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Nickel salt, single	lb.	..... –	.12 – .12½
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35
Potassium bichromate	lb.	.10½– .10¾	.11 – .11½
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80-85%	lb.	.05 – .05¾	.05½– .06
Potassium chlorate (powdered and crystals	lb.	.06½– .07	.07¼– .08
Potassium cyanide	lb.	..... –	.55 – .57
Potassium hydroxide (caustic potash) 100	lb.	5.50 – 5.75	6.00 – 6.25
Potassium iodide	lb.	..... –	3.20 – 3.35
Potassium nitrate	lb.	.06½– .06¾	.07 – .08
Potassium permanganate	lb.	.14½– .15	.15¼– .16
Potassium prussiate, red	lb.	....	.95 – 1.00
Potassium prussiate, yellow	lb.	.35 – .35½	.35¾– .36
Rochelle salts (see sodium potas. tartrate)	....	....	..... – .....
Salammoniac, white, granular	lb.	.06¼– .06½	.06¾– .07
Salammoniac, gray, granular	lb.	.07¾– .08	.08¼– .08½
Salsoda 100	lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	18.00 –21.00	......– ....
Soda ash, light, 58 per cent flat, bags, contract 100	lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale 100	lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale 100	lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07¼– .07½	.07¾– .08
Sodium bicarbonate 100	lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½– .07¾	.08 – .08½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P	lb.	.04¼– .04½	.04¾– .05¼
Sodium chlorate	lb.	.06¾– .06¾	.07 – .07½
Sodium chloride	long ton	12.00 –13.00	......–......
Sodium cyanide	lb.	.19½– .21	.21½– .25
Sodium fluoride	lb.	.09¾– .10	.10¼– .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract 100	lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale 100	lb.	3.70 – 3.75	3.80 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts 100	lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale 100	lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02¾– .03	.03¼– .03¾
Sodium nitrite	lb.	.08½– .08¾	.09 – .09½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03 – .04	.04¼– .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.23 – .23½	.23½– .24
Sodium silicate, (40 deg. in drums) 100	lb.	.80 – 1.00	1.05 – 1.25
Sodium silicate, (60 deg. in drums) 100	lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt) 100	lbs.	.90 – 1.00	1.05 – 1.50
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04 – .04½	.04½– .05
Sodium sulphite, crystals	lb.	.03½– .03¾	.03¾– .04½
Strontium nitrate, powdered	lb.	.09½– .10	.10½– .12
Sulphur chloride, yellow	lb.	.04½– .05	.05½– .06
Sulphur, crude	ton	18.00 –20.00	......– .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour 100	lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone) 100	lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 –40.00	......–......
Talc—domestic powdered	ton	18.00 –25.00	......–......
Tin bichloride	lb.	.09 – .09½	.09½– .10
Tin oxide	lb.	..... –	.35 – .37
Zinc carbonate	lb.	.14 – .14½	.14¾– .15½
Zinc chloride, gran	lb.	.5¾ – .06	.06¼– .06¾
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½– .08	.08¼– .08½
Zinc sulphate 100	lb.	2.75 – 3.00	3.05 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$1.00 — $1.05
Alpha-naphthol, refined	lb.	1.10 — 1.15
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.15 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P	lb.	1.30 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzidine, base	lb.	.85 — .95
Benzidine sulphate	lb.	.80 — .85
Benzoic acid, U.S.P	lb.	.65 — .67
Benzoate of soda, U.S.P	lb.	.53 — .55
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.50 — .55
Beta-naphthol, tech	lb.	.22 — .25
Beta-naphthylamine, sublimed	lb.	1.50 — 1.60
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.12 — .15
Ortho-cresol, in drums (100 lb.)	lb.	.16 — .18
Cresylic acid, 97-99%, straw color, in drums	gal.	.56 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.51 — .58
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	.65 — .70
Dimethylaniline	lb.	.32 — .34
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.21 — .22
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.24 — .26
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.75 — .80
Meta-phenylenediamine	lb.	.85 — 1.00
Monochlorbenzene	lb.	.10 — .11
Monoethylaniline	lb.	1.00 — 1.20
Naphthalene crushed, in bbls	lb.	.06 — .06½
Naphthalene, flake	lb.	.06½ — .07
Naphthalene, balls	lb.	.07½ — .08
Naphthionate of soda	lb.	.58 — .65
Naphthionic acid, crude	lb.	.65 — .70
Nitrobenzene	lb.	.10 — .12
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	$0.15 — $0.17
N-W acid	lb.	1.15 — 1.30
Ortho-amidophenol	lb.	2.10 — 2.15
Ortho-dichlor-benzene	lb.	.17 — .20
Ortho-nitro-phenol	lb.	.75 — .77
Ortho-nitro-toluene	lb.	.10 — .13
Ortho-toluidine	lb.	.12 — .14
Para-amidophenol, base	lb.	1.20 — 1.25
Para-amidophenol, HCl	lb.	1.25 — 1.30
Para-dichlorbenzene	lb.	.17 — .20
Paranitroaniline	lb.	.72 — .80
Para-nitrotoluene	lb.	.55 — .65
Para-phenylenediamine	lb.	1.55 — 1.60
Para-toluidine	lb.	.85 — .90
Phthalic anhydride	lb.	.35 — .38
Phenol, U. S. P., drums	lb.	.23 — .25
Pyridine	gal.	1.75 — 2.75
Resorcinol, technical	lb.	1.50 — 1.55
Resorcinol, pure	lb.	2.00 — 2.10
R-salt	lb.	.55 — .60
Salicylic acid, tech., in bbls	lb.	.25 — .27
Salicylic acid, U. S. P	lb.	.29 — .30
Solvent naphtha, water-white, in drums, 100 gal	gal.	.27 — .32
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.12 — .14
Sulphanilic acid, crude	lb.	.24 — .26
Tolidine	lb.	1.20 — 1.30
Toluidine, mixed	lb.	.30 — .35
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.30 — .35
Xylidines, drums, 100 gal	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — ....
Xylene, commercial, in drums, 100 gal	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — ....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.19½— $0.20
Beeswax, refined, dark	lb.	.30 — .32
Beeswax, refined, light	lb.	.34 — .35
Beeswax, pure white	lb.	.38 — .42
Candelilla, wax	lb.	.38 — .40
Carnauba, No. 1	lb.	.40 — .42
Carnauba No. 2, North Country	lb.	.25 — .26
Carnauba, No. 3, North Country	lb.	.18 — .18½
Japan	lb.	.16 — .16½
Montan, crude	lb.	.03½— .04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04¼— ....
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½— ....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¼— .03½
Paraffine waxes, refined, 125 m.p.	lb.	.03½— .03¾
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 — .04¼
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½— .04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 — .05¼
Stearic acid, single pressed	lb.	.09 — .09½
Stearic acid, double pressed	lb.	.09½— .09¾
Stearic acid, triple pressed	lb.	.10½— .10¾

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.25 — $6.30
Rosin E-I	280 lb.	6.35 — 6.40
Rosin K-N	280 lb.	6.45 — 6.65
Rosin W. G.-W. W	280 lb.	7.85 — 8.40
Wood rosin, bbl	280 lb.	6.25 — .....
Spirits of turpentine	gal.	1.23 — 1.24
Wood turpentine, steam dist	gal.	.85 — .....
Wood turpentine, dest. dist	gal.	.70 — .70
Pine tar pitch, bbl	200 lb.	...... — 6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	...... — 9.50
Retort tar, bbl	500 lb.	— 9.00
Rosin oil, first run	gal.	.36 — .....
Rosin oil, second run	gal.	.38 — .....
Rosin oil, third run	gal.	.46 — .....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.	1.00
Pine oil, pure, dest. dist	gal.	.95
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.	.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.	.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.	.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.	.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.	.25
Pinewood creosote, ref	gal.	.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.70 — 3.75
Blood, dried, f.o.b., N. Y	unit	4.75 — .....
Bone, 3 and 50, ground, raw	ton	37.00 — 39.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 — 3.20
Nitrate of soda	100 lb.	2.50 — 2.55
Tankage, high grade, f.o.b. Chicago	unit	4.50 — 4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 — 4.00
Tennessee, 78-80%	ton	7.00 — 8.00
Potassium muriate, 80%	ton	33.00 — 34.00
Potassium sulphate	unit	1.00 — .....

Crude Rubber

Para—Upriver fine	lb.	$0.18½— .18¾
Upriver coarse	lb.	.13½— .13¾
Upriver caucho ball	lb.	.13½— .13¾
Plantation—First latex crepe	lb.	.14 — .14¼
Ribbed smoked sheets	lb.	.14 — .14¼
Brown crepe, thin, clean	lb.	.13½— ...
Amber crepe No. 1	lb.	.14 — ...

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12½ —	$0.13
Castor oil, AA, in bbls	lb.	.13 —	.13½
China wood oil, in bbls	lb.	.12½ —	.12¾
Coconut oil, Ceylon grade, in bbls	lb.	.08¼ —	.08½
Coconut oil, Cochin grade, in bbls	lb.	.09 —	.09½
Corn oil, crude, in bbls	lb.	.10½ —	.10¾
Cottonseed oil, crude (f. o. b. mill)	lb.	.08 —	.08
Cottonseed oil, summer yellow	lb.	.10¾ —	.11
Cottonseed oil, winter yellow	lb.	.11½ —	.12
Linseed oil, raw, car lots (domestic)	gal.	.87 —	.88
Linseed oil, raw, tank cars (domestic)	gal.	.82 —	.83
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.89 —	.90
Olive oil, denatured	gal.	1.15 —	1.17
Palm, Lagos	lb.	.06¾ —	.07
Palm, Niger	lb.	.06 —	.06½
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.09½ —	.09¾
Peanut oil, refined, in bbls	lb.	.12 —	.12½
Rapeseed oil, refined in bbls	gal.	.82 —	.83
Rapeseed oil, blown, in bbls	gal.	.88 —	.89
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11¾ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09¾ —	....

FISH

Light pressed menhaden	gal.	$0.53 —	....
Yellow bleached menhaden	gal.	.54 —	.55
White bleached menhaden	gal.	.56 —	.57
Blown menhaden	gal.	.61 —	....
Whale Oil, No. 1. crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

All f.o.b. New York, Unless Otherwise Stated

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$700.00	$750.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	65.00	—100.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	14.00	— 17.00
Barytes, ground, white, f.o.b. mills	net ton	17.00	— 23.00
Barytes, ground, off color f.o.b. mills	net ton	13.00	— 21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00	— 24.00
Barytes, crude f.o.b. mines	net ton	8.00	— 9.00
Casein	lb.	.10½	— .13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00	— 8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00	— 9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	12.00	— 20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00	— 12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	13.00	— 20.00
China clay (kaolin), imported, lump	net ton	16.00	— 20.00
China clay (kaolin), imported, powdered	net ton	30.00	— 35.00
Feldspar, No. 1 pottery grade	long ton	6.50	— 6.75
Feldspar, No. 2 pottery grade	long ton	5.75	— 5.90
Feldspar, No. 1 soap grade	long ton	7.00	— 7.50
Feldspar, No. 1 Canadian, for mill	long ton	21.00	— 22.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y.	lb.	.05	— .05½
Graphite, Ceylon chip	lb.	.04	— .04½
Graphite, high grade amorphous crude	ton	35.00	— 50.00
Kieselguhr, f.o.b. mines, Cal.	per ton	40.00	— ....
Kieselguhr, f.o.b. N. Y.	per ton	50.00	— 55.00
Magnesite, crude, f.o.b. California mines	per ton	8.00	— 12.00
Pumice stone, imported	lb.	.03	— .05
Pumice stone, domestic, lump	lb.	.05	— .05½
Pumice stone, domestic, ground	lb.	.06	— .07
Shellac, orange fine	lb.	.70	— .71
Shellac, orange superfine	lb.	.72	— .73
Shellac, A. C. garnet	lb.	.70	— .71
Shellac, T. N.	lb.	.68	— .69
Silica, glass sand, f.o.b. Indiana	per ton	1.50	— 2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50	— 5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	16.00	— 16.00
Silica, building sand, f.o.b. Pa.	per ton	2.00	— 2.75
Soapstone	ton	12.00	— 15.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00	— 12.00
Talc, 200 mesh, f.o.b. Georgia	ton	7.50	— 12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	16.00	— 20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per 1,000	$130.00
Chrome brick, f.o.b. Eastern shipping points	net ton	40-42
Chrome cement, 40-50% Cr_2O_3	net ton	23-27
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	28-35
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	26-28
Magnesite brick, 9-in. straight (f.o.b. works)	net ton	56
Magnesite brick, 9-in. arches, wedges and keys	net ton	70
Magnesite brick, soaps and splits	net ton	90
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	33-35
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	35-40
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.	1,000	31-33
Silicon carbide refractory brick, 9-in.	1,000	1100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.10 —	10½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.10½ —	.11
Ferromanganese, 78-82% Mn, domestic	gross ton	67.50 —	69.00
Spiegeleisen, 19-21% Mn	gross ton	36.00 —	.....
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	1.85 —	2.00
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	58.00 —	60.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.42½ —	.45
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	......
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	ton	21.00 —	22.00
Coke, foundry, f.o.b. ovens	net ton	13.00 —	14.00
Coke, furnace, f.o.b. ovens	net ton	10.00 —	11.00
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.29 —	.....
Manganese ore, chemical (MnO_2)	net ton	60.00 —	65.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.45 —	.50
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	27.00 —	......
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.10½ —	.11
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.13½
Pyrites, domestic, fines, f.o.b. mines, Ga.	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	3.00 —	3.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	3.25 —	3.50
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.25 —	1.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb.
Copper, electrolytic	14.00
Aluminum, 98 to 99 per cent	19.10
Antimony, wholesale lots, Chinese and Japanese	5.375
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00-33.00
Nickel, ingot and shot, resale	30.00-31.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	32.625
Lead, New York, spot	5.90
Lead, E. St. Louis, spot	5.55
Zinc, spot, New York	6.55-6.60
Zinc, spot, E. St. Louis	6.20-6.25

OTHER METALS

Silver (commercial)	oz.	$0.69½
Cadmium	lb.	1.20-1.25
Bismuth (500 lb. lots)	lb.	2.00@2.10
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.15@1.25
Platinum	oz.	$108.00
Iridium	oz.	Nominal
Palladium	oz.	55.00@60.00
Mercury	75 lb.	61.00

FINISHED METAL PRODUCTS

	Warehouse Price, Cents per Lb.
Copper sheets, hot rolled	19.50
Copper bottoms	29.50
Copper rods	19.50
High brass wire	18.25
High brass rods	16.25
Low brass wire	19.60
Low brass rods	20.25
Brazed brass tubing	23.00
Brazed bronze tubing	28.00
Seamless copper tubing	23.75
Seamless high brass tubing	21.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	10.25@10.50
Copper, heavy and wire	10.00@10.25
Copper, light and bottoms	7.75@ 8.25
Lead, heavy	3.90@ 4.15
Lead, tea	2½-2¾
Brass, heavy	4.50@ 4.75
Brass, light	4.00@ 4.25
No. 1 yellow brass turnings	4.00@ 4.25
Zinc	2.00@ 2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.70	$2.70
Soft steel bars	2.60	2.60
Soft steel bar shapes	2.60	2.60
Soft steel bands	3.10	3.20
Plates, ¼ to 1 in. thick	2.70	2.70

Industrial

Financial, Construction and Manufacturers' News

Industrial Developments

PAPER—The Lititz Box Board & Paper Co., Eden, near Lancaster, Pa., has adopted a 24-hour daily working schedule at its plant, under a 7-day operating basis, giving employment to a large working force. It is said that orders on hand insure this capacity for some time to come.

The H. H. Bartin & Son Co., Philadelphia, Pa., manufacturer of sandpaper, is operating on a full-time schedule at its plant, giving employment to a regular working force. The company is now building a 2-story addition, and will place the structure in service at the earliest possible date.

The Tonawanda Board & Paper Co., Goose Island, Tonawanda, N. Y., heretofore operated by the Beaverboard Companies, Buffalo, and recently acquired by new interests, is planning for the immediate resumption of production at the mill, which has been closed down for about 3 years past. The new company is headed by Maurice W. Simon, Buffalo.

The Temiskaming Pulp & Paper Co., Haileybury, Ont., will commence operations at once at its new local mill, recently completed at a cost of about $1,000,000, giving employment to a large working force. Initial production will be increased gradually until the plant capacity of 40 tons per day, ground-wood pulp, is reached.

The Jesperson Newsprint Co. has reopened the former Perseverance Paper Mill, South Union St., Lambertville, N. J., recently acquired, following considerable rebuilding and remodeling. The plant will manufacture newsprint paper under a new process, and will operate at a capacity basis. Henry Weeks is general manager.

LEATHER—The Benz Kid Co., Lynn, Mass., is increasing operations at its tannery and is now manufacturing at the rate of about 1,000 dozen skins daily.

The Graton & Knight Mfg. Co., Worcester, Mass., has advanced production at its tannery at St. Louis, Mo., to about 75 per cent of normal. At the local finished leather plant at Worcester, the working force has been increased from 700 to 1,200 persons.

IRON AND STEEL—The steel mill of the Driscoll-Reese Co., Hamburg, Pa., closed for a number of months past, has been acquired by new interests and will be placed in operation at once. The machinery will be repaired and additional equipment installed. A new company will be formed to run the mill.

The Eddystone Steel Co., Eddystone, Pa., has closed its plant temporarily owing to fuel shortage. The plant has been giving employment to about 200 men.

The Tacony Steel Co., Tacony, Philadelphia, Pa., is operating at full capacity at its rolling mills and at close to 50 per cent output in other departments of the works. The company has recently changed two of its four furnaces to utilize oil as fuel.

The Youngstown Sheet & Tube Co., Youngstown, O., is increasing production at its local bessemer plant, following a resumption of operations recently curtailed on account of fuel shortage. One of the bar mills at the works is in service, running at full capacity.

The Eastern Steel Co., Pottstown, Pa., will make immediate repairs in its No. 1 blast furnace, and will place the unit in operation as soon as sufficient fuel is available. The No. 2 blast furnace of the company has recently been blown out owing to a shortage of coke.

The National Enameling & Stamping Co. is increasing production at its sheet mills at Granite City, Ill., following a curtailment due to fuel shortage. Arrangements have been made to use oil as fuel in a number of departments. It is planned to develop maximum output at the earliest possible date. The plant is said to be about 60 days behind on orders.

The American Steel & Wire Co., Youngstown, O., has been forced to reduce operations to a point of about 35 per cent of normal, owing to coal and coke shortage.

The Republic Iron & Steel Co., Youngstown, O., has resumed operations at four of its bar mills, following a recent curtailment. Arrangements are being made to increase the finishing mill capacity at the works.

The Eastern Rolling Mills Co., Baltimore, Md., has adopted a 24-hour day working basis at its plant, for the production of steel sheets, and up to the present time the plant has not felt the effects of fuel shortage. Employment is being given to about 1,200 men, and it is said that this working force will be advanced at an early date.

Owing to coal and coke shortage, the Carnegie Steel Co. has suspended operations at five of its seventeen bar mills in the Youngstown, O., district.

The Kokomo Steel & Wire Co., Kokomo, Ind., is curtailing operations at its mills, owing to fuel shortage.

The Central Coal & Iron Co., Birmingham, Ala., has its blast furnace at Holt, Ala., ready to blow in, and will place the unit in service as soon as the fuel situation has improved.

METALS—The New Jersey Zinc Co., Palmerton, Pa., is increasing operations at its plant and practically all departments are now running on full time with full working force. New employees will be added gradually.

The Butte Copper & Zinc Co., Butte, Mont., has resumed operations at its local Emma properties, which have been closed down since early in 1921. It is expected to reach normal production within a few weeks.

MISCELLANEOUS—E. I. du Pont de Nemours & Co., Wilmington, Del., will reopen its Ashburn works at Hannibal, Mo., devoted to the manufacture of high explosives, early in September, following a shutdown for more than a year.

The Industrial Alcohol Co., Baltimore, Md., is increasing production at its Curtis Bay plant to 100 per cent capacity, for the first time in a number of months. Operations at all other plants of the company are being developed to maximum output.

The Lehigh Portland Cement Co. has curtailed operations in a number of departments at its three mills at New Castle, Pa., owing to a strike of laborers. The men have asked for a 25 per cent wage advance.

The American Tar Products Co., Woodward, Ala., is maintaining active production at its local plant with normal working force. The company has adopted a plan for using pulverized pitch as fuel instead of coal.

The L. Martin Co., Philadelphia, Pa., manufacturer of carbon and lampblack products, has advanced production to full capacity. At this time last year the works were running at about 50 per cent of normal. It is said that orders on hand insure maximum output for some time to come.

The Pure Oil Co., Columbus, O., operating refineries in Pennsylvania, West Virginia, Minnesota, Ohio and Oklahoma, has increased production at the plants to a basis of 30,000 bbl. a day, gross.

The United States Navy Department is arranging for the resumption of operations at its helium gas plant, Fort Worth, Tex., early in September, when an appropriation of $800,000, recently granted by Congress, will become available. It is expected to develop 8,000,000 cu.ft. of helium gas for government use during the coming year.

Capital Increases, Etc.

THE AMERICAN HARD WALL PLASTER CO., Utica, N. Y., has filed notice of increase in capital from $25,000 to $350,000, for proposed expansion.

THE KANAK CO., New York, N. Y., has been organized with a capital of $400,000, to form a consolidation of the Kanak Co., 708 6th Ave., New York, and the Deode Chemical Co. The new company will manufacture chemical specialties, with headquarters at the address noted. It is headed by H. J. Davenport, K. Burham and F. S. Mygatt.

THE MESABI IRON CO., 25 Broad St., New York, N. Y., operating iron ore properties and milling plant for the manufacture of iron ore concentrate, etc., is disposing of a stock issue of $600,000, a portion of the proceeds to be used for expansion.

THE OHIO REFINING CO., Louisville, Ky., a Delaware incorporation, manufacturer of refined petroleum products, has filed notice of increase in capital from $500,000 to $2,000,000, for proposed expansion.

THE ROCHESTER BRICK & TILE MFG. CO., Rochester, N. Y., has filed notice of reduction in capital from $84,000 to $24,000.

THE DOMESTIC COKE CORP., Fairmont, W. Va., has filed notice of increase in capital from $3,500,000 to $4,500,000, for proposed expansion.

THE ILLINOIS POWDER MFG. CO., 28 East Jackson Blvd., Chicago, Ill., has filed notice of increase in capital from $250,000 to $500,000.

THE ALBRECHT-HERD CO., Equitable Bldg., Baltimore, Md., manufacturer of salt products, has filed notice of increase in capital to $300,000.

THE ARMSTRONG CORK CO., 24th St., Pittsburgh, Pa., manufacturer of cork insulation products, etc., is arranging for an increase in capital from $17,000,000 to $30,000,000.

THE UNITED STATES GLASS CO., South 9th and Bingham Sts., Pittsburgh, Pa., has called a special meeting of stockholders on Oct. 4 to vote on a proposition to dispose of the plant and property of the company for a consideration of $1,920,000. Ernst Nickel is secretary.

THE WEST INDIA SUGAR FINANCE CORP., 129 Front St., New York, N. Y., is arranging for an increase of $835,000 in preferred stock, the proceeds to be used in connection with extensions in operations of its sugar properties in the West Indies and to provide for the merger of other sugar refineries in this district.

Construction and Operation

Arkansas

FORT SMITH—The Industrial Laboratories, North 1st St., manufacturers of floor-sweeping compounds, cleansers, etc., are planning for the immediate rebuilding of the portion of their plant, recently destroyed by fire, with loss estimated at about $18,000. W. V. Botright is head.

GRAVETTE—The Spees Vinegar Co., Kansas City, Mo., is arranging for the immediate installation of new equipment at its plant to increase the present capacity.

California

LONG BEACH—Alexander Hursh, 12 Locust St., Los Angeles, will commence the immediate erection of a new oil refinery at Cherry and Newport Aves., with initial output of about 1,500 bbl. per day. It will cost about $60,000.

RICHMOND—The Lunning Mineral Products Co., manufacturers of paint products, pigments, etc., has preliminary plans under consideration for the rebuilding of the portion of its plant, recently destroyed by fire, with loss estimated at about $30,000.

VENTURA—The Associated Oil Co., Los Angeles, plans for extensions and improvements in its local storage and distributing plant on Figueroa St., estimated to cost about $30,000.

Connecticut

BRIDGEPORT—The Sieman Hard Rubber Corp. has filed plans for the construction of a new 1-story plant addition, 60x168 ft., estimated to cost about $16,000, exclusive of equipment. Work will be commenced at once.

BRIDGEPORT—The Electrolytic Iron Co., recently organized by local interests, has leased a factory at Milford, Conn., formerly occupied by Page & Nettleton, located on New Haven Ave., for the establishment of a plant for the manufacture of pure iron by the electrolysis process. The building will be remodeled and improved, and equipment installed at an early date. The works will include a complete laboratory.

BRIDGEPORT—The Compressed Paper Box Co., 128 Thompson St., recently organized with a capital of $300,000, will take over and operate the local plant and property of the company of the same name. The reorganized company plans for extensions and improvements. J. C. Stanley is president; and F. E. Irving, treasurer.

WATERBURY—The Gulf Refining Co. has preliminary plans under way for the construction of a new storage and distributing plant on South 5th St., to include a number of 1-story buildings.

Florida

MIAMI—The Pennsylvania Sugar Co., 135 South 2nd St., Philadelphia, Pa., has construction under way on the initial units of its proposed local sugar mill. The plant will have a grinding and converting capacity of 1,000 tons of sugar cane per day. It is expected to install machinery late in the fall, and have the mill ready for service early in the coming year. The company has a 100,000-acre tract in this section. George H. Earle, Jr., is president.

Georgia

LUDOWICI—The McDonald Brick Co., recently organized, has acquired the local plant of the Ludowici-Cedalon Co., heretofore devoted to the manufacture of roofing tile products. The new owner is said to be planning for extensions, to include the production of brick and other burned clay products. It will operate with a capital of $50,000.

Indiana

FAIRMOUNT—The Graham Glass Co. will make extensions and improvements in its local plant, including the installation of a new tank and other operating equipment. The works have been closed down for this purpose, and will be reopened as soon as the installation has been completed.

FAIRMONT—The Standard Oil Co. will commence the immediate construction of a new storage and distributing plant on property in the western part of the city, recently acquired. The present works in another district will be removed to the new location.

Maine

HOWLAND—The Advance Bag & Paper Co. has construction under way on a new pulp and paper mill, and plans to have the plant equipped ready for service at an early date. The machinery will be electrically operated.

Maryland

BALTIMORE—The Solarine Co., Emerson Bldg., manufacturer of metal polishes, has plans under way for the construction of a new 1-story plant, 100x150 ft., at Eagle and Smallwood Sts., estimated to cost close to $60,000, of which amount approximately $30,000 will be expended for equipment. E. H. Glidden, American Bldg., is architect. H. A. Allen is president.

HAGERSTOWN—The Security Cement & Lime Co., Equitable Bldg., Baltimore, has plans under way for enlargements in its cement-manufacturing plant at Hagerstown, to increase the capacity approximately 50 per cent. Work will be commenced at an early date.

BALTIMORE—The James Robertson Lead Works, Inc., 827 South Howard St., will commence immediately the construction of its proposed new plant addition, to comprise a 2-story building, to cost approximately $60,000. It will be equipped for the manufacture of sheet lead and other lead products. A general contract for the work was awarded recently to the Consolidated Engineering Co., Calvert Bldg. The company is a subsidiary of the United Lead Co., New York.

BALTIMORE—The Baltimore Paper Box Co., West and Howard Sts., has acquired property on the Key Highway, heretofore used by the Key Manufacturing Co., comprising a number of buildings with aggregate floor space of about 100,000 sq.ft., for a consideration of approximately $225,000. The new owner will take immediate possession and will use the plant for general manufacture. It is planned to install new machinery to cost about $75,000.

BALTIMORE — The Republic Boiler & Radiator Co., Union Ave., Woodberry, has awarded a contract to the Claiborne-Johnson Co., Garrett Bldg., Baltimore, for the construction of a 1-story foundry, 60 x 150 ft. Work will be commenced at once. William C. Keown is engineer in charge.

FUNKSTOWN—The Tanners' Hide & Tallow Co. has tentative plans under consideration for rebuilding the portion of its plant, recently destroyed by fire with loss estimated at about $25,000, including equipment.

Michigan

GRAND RAPIDS—The Grand Rapids Tire & Rubber Corp. has plans nearing completion for the construction of a new plant unit for the manufacture of cord tires, estimated to cost close to $250,000, with machinery. L. A. Brown is president and general manager.

FILER CITY—The Filer Fibre Co., manufacturer of kraft papers and other paper products, has awarded a contract to J. O. Olsen, Muskegon, for the construction of a new 2- and 3-story mill, 72x420 ft., with extension 60x60 ft., estimated to cost about $150,000, exclusive of equipment. Work will be placed under way at once. The company has recently disposed of a bond issue of $500,000, for general plant expansion. Philip P. Schnorbach is general manager.

Massachusetts

DORCHESTER—The Tide Water Oil Co., 60 Cambridge St., Allston, Mass., will commence the immediate construction of a new storage and distributing plant on Dorchester Ave. near Locust St., Dorchester, comprising a 1- and 2-story building, with about 15,000 sq.ft. of area, estimated to cost close to $75,000.

Missouri

ST. LOUIS—The Ho-Ro-Co Mfg. Co., 110 Locust St., manufacturer of flavoring extracts, etc., has plans nearing completion for the construction of a 3-story and basement plant, 60x100 ft., at Leffingwell and Dodier Sts., to cost about $55,000. Edward Lantz, 603 Post-Dispatch Bldg., is architect. N. G. Roth is president.

ST. JOSEPH—Morris & Co., Union Stockyards, Chicago, has plans in progress for the construction of a 4-story and basement lard-refining plant at St. Joseph, to replace the factory recently destroyed by fire, with loss estimated at approximately $100,000, with machinery. The new plant, it is said, will cost in excess of this amount.

Nevada

ELY—The Nevada Consolidated Copper Co. will equip its new concentrating plant, to be constructed to replace the McGill concentrator recently destroyed by fire, for a capacity of about 4,000 tons of ore per day. The unit will form sections Nos. 3 and 4 at the main works. It is estimated to cost close to $1,000,000, with machinery.

New Jersey

MORRISTOWN—The Morristown Electric Steel Foundry, Inc., 106 Water St., recently organized with a capital of $125,000, has acquired the former plant of the Liberty Steel Co. in the Shelley Terminal district, for the establishment of a new works for the manufacture of steel castings by an electrical process. Immediate possession will be taken, and it is planned to commence production at an early date. The company is headed by J. Lovell Paulmier, Samuel B. Illingsworth and Richard B. Eurich.

TRENTON—A committee of trustees of the Empire Tire & Rubber Corp., East Clinton Ave. and Mulberry St., manufacturer of tires and mechanical rubber goods, now in receivership, is perfecting plans for a reorganization of the company. The property will be offered for sale on Sept. 13. The new organization will be headed by W. T. Baird, A. W. Pickford and former Governor E. C. Stokes.

NEWARK—The Pittsburgh Plate Glass Co., 290 Elizabeth Ave., will break ground at once for the construction of a new 1-story plant, 66x110 ft., at the foot of Chester Ave. at the Passaic River, to be equipped for the manufacture of linseed oil products. It will cost about $160,000. The company will also construct a 4-story elevator, 46x46 ft., to be used for the storage of raw material, estimated to cost about $40,000. The buildings will be used in connection with the paint division of the company.

New York

LONG ISLAND CITY—The Mathieson Alkali Works, 25 West 43rd St., New York, has leased a building on 14th St. near Van Alst Ave., Long Island City, from the Connelly Iron Sponge & Governor Co., and will equip the structure for a new experimental works.

NEW YORK — The Mesabi Iron Co., 25 Broad St., operating magnetite ore properties in Minnesota for the manufacture of iron ore concentrate, or sinter, has plans under way for extensions in the plant to handle about 30,000 tons of material per day for a finished production of approximately 10,000 tons daily. It is purposed to install new machinery at the crushing plant and other departments to more than treble the present capacity. To provide for the expansion the company is disposing of a stock issue of $600,000. D. C. Jackling is president, and W. G. Swart, vice-president and general manager.

BROOKLYN—The Norman Bronze Co., 100-12 Provost St., has filed plans for the construction of a 1-story foundry addition.

LONG ISLAND CITY—Joseph R. Greenwood is organizing a new company to operate an enameling works. The building at 66 Myrtle Ave. has been leased from the Commercial Research Corp. for the proposed plant, providing about 25,000 sq.ft. of floor space. Immediate possession will be taken, and equipment installed.

YONKERS—The Arlington Chemical Co., 100 Hamilton St., has awarded a contract to the Turner Construction Co., 244 Madison Ave., New York, for the construction of a new 4-story plant, 60x200 ft., with laboratory, to be located on Harriett St. Work will be commenced at once.

North Carolina

HIGH POINT—The Marietta Paint & Color Co., Marietta, O., has plans under way for the construction of a new 4-story plant at High Point, for the manufacture of a general line of paints and colors. It is planned to commence construction at an early date.

Ohio

AKRON—The International Lead Refining Co., East Chicago, Ind., a subsidiary of Anaconda Copper Mining Co., New York, has commenced the clearing of the site on East Talmadge Ave., North Akron, recently acquired, for the construction of its proposed new plant, for the manufacture of zinc oxide. The units to be constructed at the present time will cost about $500,000, with machinery. It is planned to build other units at a later date. E. T. Gillen, 212 Ohio Bldg., Akron, is engineer. The company is said to be planning for the construction of a new 1-story addition to its zinc oxide works at East Chicago, 50x100 ft., estimated to cost approximately $50,000, with machinery installation.

Pennsylvania

SPRING GROVE—The P. H. Glatfelter Co. will commence the immediate installation of new machinery and equipment at its local paper mill. The plant will be considerably enlarged for increased capacity.

CONSHOHOCKEN—A new 1-story foundry will be constructed at the plant of the Montgomery Foundry & Fittings Co., to be equipped for a daily production of approximately 100 tons of gray iron castings.

PITTSBURGH—The Stroh Steel-Hardening Process Co., Westinghouse Bldg., has plans nearing completion for the construction of a new addition to its steel foundry at Ridge Ave. and Chateau St., to cost about $250,000, with equipment. Work on clearing the site is under way. W. Y. Stroh is president.

Tennessee

MEMPHIS—The Indiana Board & Filler Co., Vincennes, Ind., lately organized with a capital of $750,000, has acquired the local plant of the Tennessee Fibre Co., located in the North Memphis district. The new owner will take immediate possession of the plant for the manufacture of strawboard and fiber products, with department for a complete chemical treatment of straw materials used. The present works will be enlarged and considerable new machinery installed.

Texas

FORT WORTH—The Armstrong Steel Co., recently organized with a capital of $2,500,000, to take over and operate the iron and steel plant of the George W. Armstrong Co., has plans in progress for remodeling and improving the local works, converting the plant from a present line of general iron products to the manufacture of steel specialties. New mills will be constructed and considerable machinery installed, estimated to cost approximatey $1,000,000. The company is disposing of a stock issue to provide for the expansion. George W. Armstrong is chairman of the board; R. L. Van Zandt, president; and David R. Knapp, consulting engineer, formerly connected with the Eastern Steel Co., Philadelphia, vice-president in charge of operations.

YOAKUM—In connection with the proposed expansion at the plant of the Texas Hide & Leather Co., a 1-story tanning plant will be built, 30x150 ft. Two other buildings will be erected, 50x100 ft. and 50x80 ft. respectively. J. B. Harris is general manager.

Virginia

LEXINGTON—The Board of Directors of the Washington & Lee University will install a complete chemical laboratory in a new 3-story building at the institution, for which plans are being prepared. The structure will cost about $150,000. Flournoy & Flournoy, 306 St. Paul St., Baltimore, Md., are architects.

New Companies

THE CHAPMAN PRODUCTS Co., Centerdale, North Providence, R. I., has been incorporated with a capital of $25,000, to manufacture chemical products, germicides, etc. The incorporators are M. L. Merithew, R. S. Thornton and E. B. Chapman, 131 Greenville Ave., Manton, R. I.

THE REICH-ASH CORP., New York, N. Y., care of N. D. Leıman, 291 Broadway, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are S. and L. R. Reich, and S. Ash.

THE NEW JERSEY BRICK CO., INC., Eatontown, N. J., has been incorporated with a capital of $20,000, to manufacture brick and other burned clay products. The incorporators are Eugene A. H. Watson, Walter T. Spalding and Theobald Mincer, all of Eatontown. The last noted represents the organization.

THE BURKE-GREIS OIL CO., Tulsa, Okla., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are John F. Burke, D. deLace Greis and Henry N. Greis, Tulsa. The last noted represents the company.

THE COLUMBIA LEATHER GOODS CORP., New London, Conn., has been incorporated with a capital of $500,000, to operate a tannery and manufacture leather goods. The incorporators are Inez C. Delgado, Samuel Friedman and M. P. Breen, 54 West 90th St., New York, N. Y.

THE FRAHER BRASS WORKS, INC., 14 South Jefferson St., Chicago, Ill., has been incorporated with a capital of $10,000, to manufacture brass, bronze and kindred metal products. The incorporators are L. L. Richmond, Lowell A. Lawson and Thomas T. Dudley, Jr.

THE CAROLINAS CHEMICAL CO., Columbia, S. C., has been incorporated with a capital of $100,000, to manufacture chemicals, fertilizers and kindred products. The incorporators are Iredell Jones, Jr., and W. D. Black, Columbia.

THE VENEZUELA OIL CORP., Boston, Mass., has been incorporated with a capital of $300,000, to manufacture petroleum products. Raymond D. Smith, 55 Congress St., Boston, is president and treasurer.

THE MASTER CHEMICAL CO., Rochester, N. Y., care of J. E. Whitley, attorney, Rochester, representative, has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. The incorporators are L. and P. S. Burnherr, and S. R. Joffe.

THE SEWICKLEY SOAP WORKS, INC., Sewickley, Pa., has been incorporated under Delaware laws, with a capital of $50,000, to manufacture soaps and kindred products. The incorporators are Norman B. Abercombe, Paul and R. C. Wright, Sewickley. The last noted represents the company.

THE BENSON-THARPE PAINT CO., Birmingham, Ala., has been incorporated with a capital of $50,000, to manufacture paints, varnishes, etc. Y. K. Benson is president; and W. A. Tharpe, vice-president, both of Birmingham.

THE INTERSTATE CHEMICAL CO., Providence, R. I., has been incorporated with a capital of $5,000, to manufacture chemicals and chemical byproducts. The incorporators are Philip C. Joslin, R. A. McDonald and Thurston Seabury, Cranston, R. I. The last noted represents the company.

THE RELIABLE GAS & OILS, INC., Newark, N. J., has been incorporated with a capital of $50,000, to manufacture lubricating oils, etc. The incorporators are Harry B. O'Connell, and William F. Haas, 1212 Broad st., Newark.

THE FOURLOCK TILE CORP., American Bldg., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture concrete tile blocks and kindred products. The incorporators are Harry W. Somers, William L. Broman and Frank E. Holt.

THE PHOSPHOGEN FERTILIZER CORP., Richmond, Va., has been incorporated with a capital of $10,000,000, to manufacture commercial fertilizer products. Horace S. Wright is president; and N. T. Cook, secretary, both of Richmond, Va.

ARTHUR J. CAHILL & CO., 96 Linden Ave., Jersey City, N. J., has filed notice of organization, to manufacture chemicals and chemical byproducts, dyes, etc. Arthur J. Cahill heads the company.

THE CHARLES BECK CO., Philadelphia, Pa., care of Archibald T. Johnson, 1617 Land Title Bldg., representative, is being organized to manufacture paper products. The company is headed by H. P. and L. Beck and Andrew Simon. Application has been made for a state charter.

THE INDUSTRIAL PRODUCERS' & REFINERS' CORP., Wilmington, Del., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, has been incorporated under state laws, with a capital of $12,000,000, to manufacture petroleum products.

MAXUDIN & CO., INC., New York, N. Y., care of Niles & Johnson, 54 Wall St., representatives, has been incorporated with a capital of $100,000, to manufacture oil products. The incorporators are W. R. Fuller, R. Q. Kelley and F. H. Medbury.

THE NEW YORK VITREOUS ENAMEL PRODUCTS CO., New York, N. Y., care of the United States Corporation Co., 65 Cedar St., representative, has been incorporated under Delaware laws, with a capital of $300,000, to manufacture vitreous enamel ware and kindred burned clay products.

THE SEABOARD BRASS & COPPER CO., 805 Continental Bldg., Baltimore, Md., has been incorporated with a capital of $100,000, to manufacture brass, bronze, copper and kindred products. The incorporators are Harvey H. Wilson, Edwin M. Talbot and Herbert Langrall.

THE AMERICAN GLASS EXPERIMENTAL WORKS, 104 Point St., Providence, R. I., has filed notice of organization to manufacture glass specialties. William Cepek heads the company.

THE P. M. REFINING CO., New York, N. Y., care of I. H. Bookman, 799 Broadway, representative, has been incorporated with a capital of $10,000, to operate a metal refining plant. The incorporators are A. S. Bookman and E. H. Vogel.

THE INTERSTATE OXYGEN CO., Wheeling, W. Va., has been organized under state laws to manufacture commercial oxygen products. The incorporators are H. G. Beckett, F. C. Niebergall and G. H. Helfer, all of Wheeling.

THE BRIDGEPORT BRONZE CO., Bridgeport, Conn., has been incorporated with a capital of $200,000, to manufacture bronze, brass and other kindred metal products. The incorporators are H. M. Trainor, H. L. Shaff and Jonathan Grout, 886 Main St., Bridgeport.

THE STRAW CELLULOSE PRODUCTS CO., Portland, Me., has been incorporated with a capital of $1,000,000, to manufacture paper and pulp products under a special process. Charles M. Drummond is president; R. B. Buzzell, treasurer; and Wadleigh B. Drummond, clerk, all of Portland. The last noted represents the company.

THE INDIANA OIL & SULPHUR CO., Mooresville, Ind., has been incorporated with a capital of $500,000, to manufacture oil and sulphur products and affiliated specialties. The incorporators are M. H. and Alfred L. Thomas, and Pharoah H. Hill, all of Mooresville.

THE SOMERTON FOUNDRIES CORP., Philadelphia, Pa., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under Delaware laws with capital of $250,000, to manufacture iron, steel and other metal castings. The incorporators are M. F. Devine and S. R. Kerr, Philadelphia; and C. L. Hadgkiss, Camden, N. J.

THE WESTERN OIL & REFINING CO., 1828 Second Ave., Rock Island, Ill., has been incorporated with a capital of $25,000, to manufacture refined oil products. The incorporators are James McCrory, Carl J. Mueller and Patrick L. Welsh.

THE HARLEM CORK CO., New York, N. Y., care of L. A. Cuvillier, 154 East 121st St., representative, has been incorporated with a capital of $5,000, to manufacture cork products. The incorporators are S. Becker, A. H. and C. F. Stahl.

THE SMITH-WILKINSON GUANO CO., Spartanburg, S. C., has been incorporated with a capital of $25,000, to manufacture fertilizer products. The incorporators are Floyd T. Smith and J. C. Wilkinson, both of Spartanburg.

THE GOBLE RUBBER PRODUCTS CO., Cleveland, O., care of Homer J. Smith, Wyoming, Del., representative, has been incorporated under Delaware laws, with a capital of $50,000, to manufacture rubber specialties. The incorporators are H. L. Indal Smith, M. L. Merchant and J. M. Whitford, all of Cleveland.

THE PENNSYLVANIA PRODUCTS LABORATORIES, INC., Brooklyn, N. Y., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical by products. The company is represented by F. G. Milligan, 375 Fulton St., Brooklyn. The incorporators are C. Jacob, B. Miller and A. Devine.

THE MEXIA-FREESTONE OIL CORP., Mexia, Tex., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated with a capital of $5,000,000, under state laws, to manufacture petroleum products.

SCHWARTZ BROTHERS, INC., 309 East Center St., Baltimore, Md., has been incorporated with a capital of $25,000, to manufacture lubricating oils. The incorporators are Max L. and Louis A. Schwartz.

THE BAFFETTI VULCANIZER SYSTEM, INC., 917 West Washington Boulevard, Chicago, Ill., has been incorporated under state laws, to manufacture rubber specialties, rubber reclaiming fluids, etc. The incorporators are Louis A. Baffetti and Frank Fox.

THE LAKE SHORE OIL CO., 1125 West 79th St., Chicago, Ill., has been incorporated with a capital of $20,000, to manufacture refined oil products. The incorporators are George W. and Frank B. Busch, and Walter A. Johnston.

THE GRAPHO CRAYONS CO., St. Louis, Mo., has been incorporated with a capital of $50,000, to manufacture crayons, chalks and kindred products. The incorporators are W. L. Deist and R. H. Taylor, both of St. Louis.

THE AMERICAN CARBON ELIMINATOR CO., Brooklyn, N. Y., care of W. L. Morehouse, 50 Court St., representative, has been incorporated with a capital of $20,000, to manufacture special compounds for carbon elimination. The incorporators are N. Friedman and M. M. Rutchik.

THE BEAVER PETROLEUM CO., Buffalo, N. Y., care of Robert C. Palmer, Ellicott Square, representative, has been incorporated with a capital of $500,000, to manufacture petroleum products. The incorporators are F. L. Danforth, B. Rumsey and W. S. Jackson.

THE GLOBE STEEL TUBE CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws, with a capital of $10,500,000, to manufacture steel tubing and affiliated products.

THE PEERLESS OIL CO., Richmond, Va., has been incorporated with a capital of $500,000, to manufacture refined oil products. E. E. Pratt, Paola, Kan., is president; and Guy B. Hazelgrove, Richmond, secretary.

THE AMERICAN MICA MFG. CO., Wilmington, Del., has been incorporated with a capital of $100,000, to manufacture mica products. The incorporators are Charles S. Greelman, Waynesville, N. C.; Charles E. and Frank E. Slocumb, both of Wilmington. The last noted represents the company.

THE NYPROS STEEL CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., has been incorporated under Delaware laws with a capital of $5,250,000, to manufacture steel products.

Coming Meetings and Events

ALPHA CHI SIGMA dinner, during the Chemical Exposition, will be held Thursday, Sept. 14, at 6:30 p.m. at Keen's Chop House, 107 West 44th St., New York City. Members are requested to register at *Chem. & Met.'s* booth at the Exposition.

AMERICAN CHEMICAL SOCIETY is holding its fall meeting in Pittsburgh, Pa., Sept. 5 to 9.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Montreal, Sept. 21, 22 and 23. Headquarters will be at the Windsor Hotel.

AMERICAN GAS ASSOCIATION will hold its annual convention and exhibition at Atlantic City, Oct. 23 to 28.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its 126th meeting at San Francisco, Calif., Sept. 25-29, 1922.

AMERICAN SOCIETY FOR STEEL TREATING will hold its International Steel Exposition and Convention in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS will hold its sixteenth annual convention Sept. 11 to 15 at Cleveland Public Hall, Cleveland, Ohio.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York, Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer, but will resume them in October.

SOCIETY OF INDUSTRIAL ENGINEERS will hold a 3-day national convention in New York, beginning Oct. 18. The general topic of the convention is "Economics of Industry."